

Australasian Plant Conservation

BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION INC

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Planning and implementing conservation networks in Sutherland Shire, New South Wales
Gold Coast City Council's vegetation community representation project, Queensland
Natural area planning in the Shire of Kalamunda, Western Australia
Aerial mapping of two riparian vine weeds in Tweed Shire, New South Wales
Native landscaping in the Redlands, Queensland
A global tree conservation role for an International Arboretum in Canberra
And much much more ...

SPECIAL THEME: LOCAL GOVERNMENT AND PLANT CONSERVATION

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Australasian Plant Conservation

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ANPC Inc. Mission Statement

*"To promote and improve
plant conservation"*

Contributing to Australasian Plant Conservation

Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the March–May 2010 issue is Friday 26 February 2010.** The theme of that issue will be **'Wetlands plant conservation'**. General articles are also very welcome. Please contact Rosemary Purdie if you are intending to submit an article: Rosemary.Purdie@environment.gov.au.

Authors are encouraged to submit images with articles or information. Please submit images as clear prints, slides, drawings, or in electronic format. Electronic images need to be at least 300 dpi resolution, submitted in at least the size that they are to be published, in tif, jpg or gif format. Guidelines for authors are at: <http://www.anpc.asn.au/anpc/pdf/APCGuideContrib.pdf>.

Please send articles, no more than 1100 words, as a MS Word (2000 compatible) or rich text format file, on disk or by email to: Rosemary.Purdie@environment.gov.au.

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Front cover: Chilworth Reserve Bushcare Group, Hornsby Shire. Photo: Danielle Sutton.
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From the Editor

Sue Mathams

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As someone who has worked in the conservation sections of several local governments in Australia, I can attest to the important, although arguably often under-reported, contribution that local government makes to plant conservation. Local government can greatly influence plant conservation outcomes in many ways—through, for example, its planning and development assessment responsibilities, on-ground management of its reserves, support of private land conservation incentives and engagement of local communities in on-ground conservation activities.

In this edition of *Australasian Plant Conservation* (APC) we provide a snapshot of the types of plant conservation activities local government is undertaking across Australia. Most of the articles are from local governments; many ANPC members work for local government and a number have contributed articles. While some of the articles outline specific conservation programs, others provide overviews of strategic planning processes being undertaken. Articles have been loosely grouped under the broad themes of strategic planning, use of spatial information, display gardens and general conservation initiatives.

One of the challenges for many local governments in planning for the management of biodiversity is designing a conservation network within an often highly fragmented and urbanised landscape. Such networks however have enabled local government to manage natural resources more strategically and are a useful tool for assisting and directing on-ground works such as weed eradication and revegetation. Sutherland Shire and Gold Coast City Council provide overviews of the processes they have undertaken in developing and implementing their conservation networks. Kalamunda Shire describes the development of a local biodiversity strategy which is assisting them in better protecting and enhancing the management of 400 reserves.

A number of articles describe how spatial information is being used to enhance native vegetation conservation. The Sunshine Coast Regional Council uses resilience mapping and a scoring system for its conservation reserves to prioritise on-ground work. A weed mapping project in the Tweed Shire shows how aerial mapping is being used in the fight against vine weeds which are a major threat to important riparian vegetation. In Western Australia, the Roadside Conservation Committee is assisting local government with managing their roadside vegetation by producing Roadside Conservation

Value maps. And an article about the mapping of an endangered ecological community within the Lake Macquarie local government area describes how this information will assist Council in providing greater protection to the ecological community through its planning and development assessment processes.

Planted gardens such as botanic gardens or arboreta have long been used to inspire and educate people about plants; the role of botanic gardens in plant conservation was the theme of our last APC issue of 2009. Two articles in this issue illustrate a quite different local government angle on this to meet specific plant conservation goals. Redland City Council, as part of its strategy in managing weeds, is promoting the planting of local native plants in backyard gardens through the use of demonstration gardens. These gardens display local native plants in different garden styles. The Australian Capital Territory government outlines the conservation role of the new international arboretum under development in the Territory with reference to examples of locally endangered plants.

The remaining articles provide examples of some specific programs that local governments are undertaking that are contributing to plant conservation. Quairading Shire discusses a range of initiatives that are being delivered to protect biodiversity assets in the central wheatbelt area of Western Australia. Hornsby Council gives an overview of some of its conservation programs, including just celebrating 20 years of Bushcare, where community volunteers work in council reserves to conserve and enhance them. The Australian Capital Territory government provides an overview of the challenges it faces in protecting and managing threatened species and ecosystems within its boundary and a snapshot of some of the communities and species that face a precarious future. An article from Perth Region Natural Resource Management proposes a model for better integrating natural resource management into local government core business within the Perth region and reports on the Perth Biodiversity Project, a program which assists local governments to take a strategic, consistent and integrated approach to biodiversity conservation planning.

In a thought provoking article, Andrew Crompton writes on why he considers local government is generally performing badly in the area of plant conservation within South Australia despite local government being in the best position to deliver it. He suggests the reasons are complex and identifies a number of factors that may have contributed to this situation. He advocates

for some new approaches to turn this situation around, including greater community engagement and better partnership arrangements.

Other features in this issue include the report by ANPC President Bob Makinson at the Annual General Meeting

in November 2009, and a report from ANPC Committee Member Zoë Smith from the USA. The issue is rounded off with the report from the New Zealand Plant Conservation Network and a book review. Other regular items have been deferred to the next issue. Welcome to APC 2010; please read on and enjoy.

ANPC Annual General Meeting, 27 November 2009: President's report

Bob Makinson

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In 2009 we saw steady activity by ANPC, and a couple of big achievements. A complete turnover of staff, and the new and difficult funding environment, meant that we ran fewer events than in recent years, and there was a backward trend in our funding base. However, we are likely to be able to partially reverse these negative trends in 2010.

Staffing and governance

We had three staff retirements during 2009. Sally Stephens (Project Manager since 2004) and Pam Strickland (Office Manager since 2004) both departed, having made a huge contribution to our organisation. Bruce Boyes gave us a valuable three months in the former position before being headhunted elsewhere.

We are very fortunate to have secured the services of Sue Mathams as Project Manager and Merryl Bradley as Office Manager; they settled in and quickly had the office humming along. Sue brings to the ANPC a wealth of practical experience in conservation, while Merryl has brought a new level of systematic organisation to the national office, and an increasing level of attention to membership contact (including chasing membership renewals—you know who you are!). Odette Mayne has been a consistent volunteer in the office; her background work is seldom visible but much valued. We were also fortunate to have Adrian Fethers come into the Treasurer position—a vital job if we are to anticipate trends and problems ahead of time.

Events

The biggest event of 2009 was a very successful National Forum, held in April at Halls Gap, Victoria. The theme *Minding our own biodiversity: conservation on private land*



ANPC President:
Bob Makinson

drew 124 people (maximum capacity for the venue). We owe a big vote of thanks to the organising group of Deanna Marshall, Paul Gibson-Roy and Zoë Smith, aided by Sally Stephens and Bruce Boyes. A highlight talk was by Andrew Campbell, one of the founders of the Landcare movement, who gave one of the most incisive guest speaker presentations we've had for a long time. His core message, a call for the recognition of Landcare as a priceless national asset and for its renewal, was reproduced in part in *Australasian Plant Conservation* (APC) issue 18(1). We are grateful for the

support given to the forum by Land & Water Australia, the Victorian Department of Sustainability & Environment, Greening Australia Victoria, the Wimmera and Glenelg Hopkins CMAs, The Grampians Winery, and the Norman Wettenhall Foundation who part-funded the publication of forum papers in APC.

The new office team organised and delivered two one-day workshops in Canberra in November, on the endlessly popular topics of *Grass identification for beginners* and *Plants of grassy ecosystems for beginners*. Both days were booked out. We are grateful for the support of staff of the Australian National Herbarium, particularly Maggie Nightingale, Brendan Lepschi, Dave Mallinson and Laurie Adams, and also to the Australian National Botanic Gardens (venue and equipment), Friends of Grasslands, Rainer Rehwinkle (DECCW), Nicki Taws (Greening Australia ACT), Isobel Crawford, Sally Stephens, and Odette Mayne. The days were supported by an ACT Government Envirogrant.

Planning is well underway for the 2010 ANPC national conference, to be held in Perth, with a planning group including (at the WA end) Dave Coates, Helena Mills, Leonie Monks, Melanie Smith, Shelley MacArthur,

Katherine Baker, Grant Wardell-Johnson and Geoff Cockerton. We are also planning for a Translocation workshop for Perth, on 24 February 2010.

Major publication

In September, a two-year project culminated with the launch by Professor Lesley Hughes of *Plant Germplasm Conservation in Australia*. This 190-page book was originally conceived as an update of our 1997 *Germplasm Conservation Guidelines*, but the explosive growth of knowledge in seed banking and seed research in the last decade resulted in a whole new book. The project demonstrates ANPC's continued ability to organise and sustain national efforts to fill gaps in the synthesis and communication of knowledge to end-users. It was run in collaboration with the Millennium Seed Bank Australian Partners (AusCaR), and was supported by the Millennium Seed Bank (MSB), the Australian National Botanic Gardens, the South Australian Department for Environment & Heritage, the Botanic Gardens of Adelaide, and the Exchange Incentive Fund. Particular thanks are owed to the editors (Cathy Offord and Patricia Meagher) and the MSB Australia Co-ordinator (Tom North), as well as to the 13 chapter co-authors and a range of other contributors. The book is being marketed by ANPC and by CSIRO Publishing.

Outreach

Our bulletin, *Australasian Plant Conservation*, has continued to publish high-quality information relevant to a wide range of plant conservation practitioners, under the general editorship of Rosemary Purdie. Full PDFs of the content are now available on the RMIT's Informit website (www.informit.com.au).

Our outreach efforts have been augmented by the new electronic bulletin *ANPC News* (<http://anpcnews.blogspot.com/>), which provides useful information via email or RSS updates. This has replaced the old email bulletin, which went automatically to all members. Please note that the new ANPC News is an *opt-in* system—you must subscribe (free) to get it, and so far only a proportion of ANPC members have done so.

National Office capabilities were hampered over the last two years by problems with the old email system—now finally solved—and by the mixed benefits and drawbacks of the website being hosted on a departmental site. While we are as ever grateful to the Australian National Botanic Gardens for hosting us physically and electronically, the website updates have usually required specialist assistance, and we are very grateful for the frequent patient help of Murray Fagg (ANBG) and Siobhan Duffy (CSIRO). We are now revamping the website, and will soon have a capability for our staff to easily add and edit content. In 2010 we will need to improve the content and relevance of the website to take advantage of this; better use of the website should form a major part of our 2010 Strategic

Plan review. We look to our New Zealand colleagues in the NZ Plant Conservation Network as an example of what can be done with an imaginative website (www.nzpcn.org.nz), and we would welcome suggestions and draft content from members and users.

Funding base

It has not been a good year for funding, partly due to the lower level of events with a fund-raising component, and partly to the external funding environment. The global financial crisis has had an effect in constraining the budgets of government and quasi-government funding bodies, and a noticeable effect on the philanthropic sector.

We have given high priority to generating more grant applications over the last year, and have had a moderate success rate, but we have not been able to meet our target of around \$70,000 p.a. from this income source. We did however secure \$15,000 per year for three years (2009-11) from the NSW Environmental Trust's *Leading Environmental Community Groups* program, and have received smaller grants from the ACT Government and Norman Wettenhall foundation that have helped to sustain our activity. But we need to ramp up our events activity sharply in 2010, as well as seeking grant money *per se*.

The big disappointment of the year for us, and for many other organisations, was the *Caring for Our Country* round of Commonwealth grants. The Commonwealth government has essentially made the same mistake as did the Howard government in the early years of the Natural Heritage Trust (NHT). Sadly they have put all environmental money into one large un-stratified pot, imposing a single set of funding criteria of somewhat dubious strategic value, and expected the entire conservation sector to compete against each other (with partnerships formed more for chasing single grants than for any strategic purpose). Furthermore there is no ensured continuity of the criteria—the next round (for which the Business Case is now well overdue) may be quite different.

If the NHT pattern is followed, we can expect a little more stratification and devolution of grants in the next *Caring for Our Country* round, and perhaps a less idiosyncratic set of criteria. In a couple more rounds we may get back to a well-stratified system with some predictability of criteria and priorities from round to round. But the price of re-invention and re-badging has already been very high. Even such a productive body as Land & Water Australia has been summarily axed. The WWF's Threatened Species Network was not funded and has been mothballed, although its two specifically plant groups—the Threatened Plant Action Groups in South Australia and Tasmania—have thankfully been given a soft landing by support from the SA Nature Conservation Society and Wildcare respectively.

ANPC has been able to diversify its income base somewhat in recent years, and our ability to supplement our membership and courses income with grants from NSW, ACT, Victorian and SA sources has kept us afloat.

However, further geographical and funding-source diversification is needed. Above all, we need to increase the number of ANPC events that are strategically useful for conservation but which are also effective in raising steady, not necessarily spectacular, income. We need to develop some regular set-piece events each year, such as annual regional courses or workshops, in addition to chasing grants reactively.

2010 Strategic Plan renewal

These issues all form part of the backdrop for the revision of our Strategic Plan in 2010. As with the expiring Plan, we hope to keep this as practical and as plain-English as possible. The new 2010 Management Committee will be responsible for the process, and we hope to involve a large section of the ANPC membership. It's your Network, and we need your ideas and energy. To this end, all members will be receiving a brief questionnaire asking for views on priorities.

2010 Committee

Some long-standing committee members retired from the Committee at the 2009 AGM. Judy West was President from 2003-2007 and a Committee member since then; Deanna Marshall, Roger Good and Leonie Monks have all served as 'ordinary' members of the Committee. All four have been *extraordinary* stalwarts of the plant conservation cause and major contributors to ANPC's work, and will continue to be involved with ANPC activities. The thanks of the whole organisation go to them for their energy and commitment.

The members of the new 2010 Committee are listed inside the cover of this issue of APC. I'd like to congratulate all those elected or re-elected at the AGM, and to particularly welcome new Committee members Sally Jacka, Paul Donatiu, Noushka Reiter and Mark Richardson.

ANPC President, Bob Makinson

Independent review of the *EPBC Act 1999*: final report

The final report of the review of the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* was released on 21 December 2009. It contains 71 recommendations for reform of the Act, and follows extensive consultation since the review was initiated on 31 October 2008. Some recommendations are directly relevant to plant conservation, and include the following.

- That Australian, State and Territory governments move to a single national list of threatened species, including marine species and ecological communities, through accreditation of State and Territory processes for listing endemic species (Recommendation 5).
- That the Act be amended to include 'ecosystems of national significance' as a new matter of national environmental significance. The 'matter protected' should be the ecological character of a listed ecosystem. Criteria for identifying such ecosystems are included (Recommendation 8).
- That the Act be amended to include vulnerable ecological communities as a matter of national environmental significance (Recommendation 14).
- That the Act be amended to give the Environment Minister the power to make emergency listings of threatened species and ecological communities under certain circumstances (Recommendation 16).
- That the Act be amended to allow greater flexibility in the development of recovery and threat abatement plans, particularly to allow for their development at regional scales, and to create opportunities for better linkages to funding initiatives.
- That the Act be amended to provide for greater flexibility in the development and implementation of Threat Abatement Plans and allow transition to regional planning approaches and strategic threat management.

The report also recommends that the Australian Government establish an independent Environment Commission to advise it on project approvals, strategic assessments, bioregional plans and other statutory decisions. Nine fact sheets and the full report (titled 'The Australian Environment Act: Report of the Independent review of the *Environment Protection and Biodiversity Conservation Act 1999*') can be downloaded from the web site <www.environment.gov.au/epbc/review/publications/final-report.html>.

Planning and implementing conservation networks in Sutherland Shire, New South Wales

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Introduction

Sutherland Shire encompasses an area of 370 km² on the southern outskirts of Sydney. The area contains significant areas of national parks and nature reserves, along with large remnants of urban bushland. The area is predominantly Hawkesbury sandstone, with minor overlying areas of sand and shale. The vegetation beyond the formal reserve system is found on both public and private lands, in remnants ranging in size from 0.1 ha to over 100 ha. These remnants experience varying degrees of isolation, ranging from reserves connected by corridors more than 100 m wide to small isolated reserves separated by several kilometres. Remnants also contain a variety of vegetation types from well represented gully forest occupying substantial areas, to endangered ecological communities and threatened species found in only small remnants. The challenge for Council has been to design a conservation network to assist in managing biodiversity in such a fragmented and diverse environment.

Researching design parameters

After searching the literature to find specific design parameters for conservation networks in urban areas and finding very little, I commenced a study to identify if fragmentation thresholds existed for biodiversity within our area (Drinnan, 2005). I selected several reserves of varying sizes and degrees of connectivity and isolation, and examined the biodiversity within them, specifically the species richness of plants, birds, frogs and fungi. The results from this study, along with the general principles identified in extensive literature searches, were used to develop a series of design guidelines for our conservation network.

Conservation network design guidelines

My research found a threshold in reserve size of approximately 3.5 ha, below which species richness declined rapidly. A further threshold of 50 ha was also noted, above which species composition changed with significantly more forest interior and rarer species present compared to generalist or urban tolerant species. Therefore remnants of these sizes and above were seen as keystones in our conservation network. Other fragmentation parameters such as corridor width and distance to reserves were found to have a linear relationship, with species



Council and students undertake habitat restoration works as part of the Schools in Greenweb Program, Sutherland Shire. Photo: Geoff Doret.

richness decreasing with separation distance and richness increasing with increased corridor width, but no thresholds were identified. Accordingly within the network larger reserves were ideally connected by wider corridors (Table 1).

Table 1. Corridor width guidelines for remnants of different size.

Remnant size	Desirable minimum corridor width
> 100 ha	> 200 m
50–100 ha	80–100 m
5–50 ha	30–80 m
2–5 ha	15–30 m
< 2 ha	Continuous canopy

Conservation network—from theory to practice

Once the basic guidelines for the design of the network had been developed, the on-ground works commenced. The vegetation of the Shire was mapped, utilising existing databases, aerial photographs and field surveys as required. Identified remnants of vegetation then formed the building blocks of a Greenweb Conservation Network (Greenweb) for Sutherland Shire.

Within the Greenweb, remnants and sites were identified as follows.

- *Core areas*—areas of high significance to the sustainability of the Greenweb as they contain key habitat areas, key linkages and threatened species or endangered ecological communities. These key habitats are of a size that maintains their viability and are generally larger than 3.5 hectares.
- *Support areas*—areas that provide ancillary habitat or secondary linkages between habitats. They also contain lands that form a buffer between developments adjacent to key habitats and corridors.
- *Restoration areas*—areas that provide opportunities for the establishment and revegetation of corridors between core areas.

Core areas comprise the key elements of the Greenweb. However these core areas are not sustainable in isolation and corridors are necessary to connect them. In some instances these corridors already existed and were identified as support areas. Where there was a need to create corridors these were identified as restoration areas (Figure 1).

In addition to a site's ability to fulfil a particular conservation role, preference was also given to sites that may play a role in water quality improvement, particularly riparian areas, and sites which may facilitate pedestrian as well as fauna movement. This enabled Council to obtain multiple benefits from some areas within the Greenweb.

From development to implementation

Once developed, the Greenweb provided the basis for conservation action in three key areas: development controls; prioritising Council natural resource management actions; and opportunities to support biodiversity conservation on private property.

Greenweb development controls

Specific planning controls relating to areas identified within the Greenweb have been incorporated into the *Sutherland Shire Development Control Plan 2006*. The development controls aim to:

- maintain habitats in a size and configuration that ensures their ongoing viability and sustainability
- ensure connectivity between remnants is maintained with corridor widths commensurate to the size of habitats they connect
- minimise off-site impacts to adjoining bushland from weed invasion, stormwater and pollutant runoff
- landscape with appropriate indigenous species to maintain and enhance core habitats and vegetated linkages.

Greenweb and Council natural resource management

Sutherland Shire Council has a range of programs that support and enhance the natural environment of the local government area. These include tree issue programs, community bushcare, street tree planting, Council bush regenerators, noxious weed officers and pest species



Figure 1. A portion of the Sutherland Shire Greenweb Network.
Key: Dark = Core areas, Mid = Support areas, Light = Restoration areas.

officers. While the operations of staff and operational work units are governed by annual work programs, they are often historically based or reactionary in nature. The Greenweb creates a new framework by which works can be prioritised and approached in a more strategic manner. This ensures that valuable Council and community resources are allocated to areas where they will have the greatest conservation benefit.

Greenweb community support program

While many of the key areas of the Greenweb are located on public lands, many other areas—in particular corridors and linkages—are located on private property. In recognition of the significant role these lands play in the overall conservation of biodiversity within Sutherland Shire, Council offers residents within these areas support and assistance in managing biodiversity assets on their land. Support under the program includes:

- vouchers for trees and shrubs from the Council nursery
- supply and collection of weed bags
- advice on weed control, plant selection and habitat creation
- additional greenwaste collection service
- regular information, newsletters and fact sheets
- small grants (up to \$2000) to undertake habitat restoration works on their property.

The Greenweb program has proven very popular within the community with 12 schools and more than 350 residents currently participating in it.

Conclusion

The development of the Greenweb Conservation Network has been a key step in the effective identification and management of biodiversity within Sutherland Shire. The Network has enabled Council to strategically manage its natural resources and to prioritise traditional work programs to obtain maximum conservation benefits. In basing the development of the Network on sound scientific principles, Council is also in a strong position for its external operations, such as defending conservation based planning decisions in the New South Wales Land & Environment Court and attracting external grant funding.

Reference

Drinnan, I.N. (2005). The search for fragmentation thresholds in a Southern Sydney suburb. *Biological Conservation* 124: 339-49.

Gold Coast City Council's vegetation community representation project, Queensland

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²Gold Coast City Council, Gold Coast.

Introduction

Located at the overlap of subtropical and temperate zones, Gold Coast City is located in one of the most biodiverse areas in Australia. Contributing to this biodiversity are internationally acclaimed protected areas including the World Heritage-listed Gondwana Rainforests and the Ramsar Convention listed coastal wetlands of southern Moreton Bay.

The city also lies within Australia's fastest growing region, attracting an average of 15 000 new residents each year. This growth is expected to continue with the State Government's South East Queensland Regional Plan making provision for an additional 137 500 new dwellings by 2031.

Numerous Council programs endeavor to address the impacts on the City's biodiversity associated with such growth. The vegetation community representation project was commissioned to assist in informing all Council actions aimed at expanding and managing the conservation network. These actions include: the Open Space Preservation Levy Land Acquisition Program, public open space dedication through the development assessment process, Council's Conservation Partnerships Program (Voluntary Conservation Agreement, Land for Wildlife etc.), and the conservation reserve system (see next article by Caddick and Ford).

The vegetation community representation project:

- determined the representation of each of the City's mapped 74 vegetation communities within the conservation network;
- identified gaps in representation of vegetation within the Gold Coast conservation network; and
- identified priority areas and, where possible, sites for future acquisition and/or management review where they occur on reserves not currently managed for conservation purposes or would be best managed under a Voluntary Conservation Agreement.

The project required a staged analysis of historic and current representations of different vegetation communities within the conservation network across the City. Stage 1 involved a desktop review of the current representation of vegetation communities (2008) and comparison with historic (1998) representation of vegetation communities within the conservation network to identify gaps. Stage 2 involved a workshop with Council and external stakeholders to

define strategic priorities for vegetation conservation/representation within the conservation network. Stage 3 involved an independent review and recommendation of priority areas and, where possible, sites for acquisition and/or protection through changed management.

Stage 1: desktop review

To develop a framework by which gaps in the conservation network could be identified, it was necessary to categorise available mapping data. It has been long recognised that once vegetation cover drops below key thresholds species diversity declines, in some instances irrevocably. Sattler and Williams (1999) identified three thresholds that have been utilised to define the status of regional ecosystems¹:

- <10% remaining. Endangered: where '*... severe degradation has occurred over an extensive area*'.
- 10-30% remaining. Of concern: where '*... moderate degradation has occurred*'.
- >30% remaining. Not of concern: where '*... little to no degradation has occurred*'.

These thresholds were utilised to assist in analysing the effectiveness of the conservation network in representing the vegetation communities of the City. An initial sweep of the data identified 27 vegetation communities for which >30% pre-clearing representation has been achieved. As these were regarded as adequately represented they were no longer considered in the study. The remaining 47 communities that had not yet achieved 30% representation were then further classified as follows.

- Communities that will never achieve 10% representation of pre-clearing extent in the conservation network due to historical clearing.
- Communities that could potentially achieve 10-30% of pre-clearing representation in the conservation network based on extent remaining in the City.
- Communities that could potentially achieve 30% or greater of pre-clearing representation in the conservation network based on extent remaining in the City.

The pattern of development of the Gold Coast has meant that vegetation associated with lower coastal areas has been significantly impacted by clearing. As a general rule, vegetation communities occurring at altitude in

¹ Regional Ecosystems in Queensland are specific vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.

the west are well protected, those on the lower foothills of metasediment have been moderately impacted, and vegetation types associated with alluvial environments and coastal dunes have been significantly impacted by historical clearing.

Due to this pattern of clearing, lowland communities including Blackbutt Forests, coastal heaths and swamps are generally poorly represented in reserves and make up a large proportion of those communities for which <10% or 10%-30% protection could be achieved. Given the terrain and proximity to existing development, these lowland areas have remained in demand for development. Consequently, vegetation communities in lowland areas have historically been difficult to attain in reserves due to their scarcity and high dollar value.

Stage 2: expert workshop

On completion of the desktop review a one day workshop was held to establish threshold criteria to further inform actions to expand the conservation network. These included:

- quantifiable factors that define an area or property for priority acquisition (including factors such as minimum patch size and minimum reserveable area incorporating buffers) for under-represented vegetation communities; and
- options, where possible, to change the management intent for parts of non-conservation reserves containing under-represented vegetation communities.

Input from the Queensland Herbarium and neighboring local governments was useful in determining whether target vegetation communities were already adequately represented in the region.

Minimum suggested patch sizes were established through the workshop for each vegetation type, based on its ecological sensitivity, and the estimated minimum reserveable area (i.e. the total area of the reserve required

to assist in maintenance of ecological integrity). Example thresholds for selected vegetation communities are presented in Table 1.

Stage 3: recommendations

Stage 3 applied the above criteria to the mapped vegetation mosaic of the City to assist in identifying potential locations for expanding the conservation network. Additional criteria were also considered when interrogating the mapping, as shown below.

1. Is the vegetation type well represented in nearby conservation estate outside of the Gold Coast local government area? If so, the priority for acquisition may be reduced.
2. Sites that support multiple vegetation communities that are currently underrepresented would be preferred.
3. The largest examples of vegetation types would be preferred given they are more likely to be integral.
4. Priority might first be given to vegetation communities that can't achieve 10% representation, then to those that can achieve 10% representation, and finally to those that can achieve 30% representation.

Conclusion

Programs aimed at expanding the City's conservation network consider multiple factors when prioritising sites, such as the presence of significant flora species or the provision of important ecological linkages. This study provided an additional valuable tool to assist Council officers in establishing a locally comprehensive and representative reserve network in the rapidly developing Gold Coast City.

Reference

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Table 1. Selected vegetation communities and their recommended thresholds.

	Level of protection achievable in the conservation estate		
	<10%	10-30%	>30%
Vegetation Type (and Regional Ecosystem) code (from Sattler & Williams, 1999)	3a (12.9-10.4)	29 (12.11.10)	4 (12.11.5)
Description	Scribbly Gum / Pink Bloodwood (<i>Eucalyptus racemosa</i> / <i>Corymbia intermedia</i>) Woodland on Sedimentary Rocks (see Figure 1)	Sub-tropical to Warm Temperate Vine Forest on Metasediments	Spotted Gum/Ironbark (<i>Corymbia citriodora</i> / <i>Eucalyptus crebra</i> / <i>E. siderophloia</i>) Woodland on Metasediments (see Figure 2)
Recommended minimum vegetation type patch size (ha)	0.2	0.2	5
Minimum extent of remnant vegetation in which the vegetation type should occur (ha)	All patches should be investigated	10	10



Figure 1. Scribbly Gum (*Eucalyptus racemosa*) / Pink Bloodwood (*Corymbia intermedia*) Woodland.
Photo: David Fancis.



Figure 2. Spotted Gum (*Corymbia citriodora*) / Ironbark (*Eucalyptus crebra*, *E. siderophloia*) Woodland.
Photo: David Fancis.

Establishing a resilient local government conservation reserve network on public land on the Gold Coast, Queensland

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Council's conservation estate

Gold Coast City is located in South East Queensland, and is one of the most biodiverse areas in Australia. Behind the high rises and developed coastal strip around 49 per cent of the city's land area is covered in native vegetation (Gold Coast City Council, 2009a). However, rapid population growth, together with environmental issues such as climate change, is placing mounting pressure on the remaining natural ecosystems.

Part of Gold Coast City Council's approach to managing these threats is the establishment of a comprehensive, adequate and representative conservation network of extensive tracts of habitat (Gold Coast City Council, 2009a). Through its Open Space Preservation Levy Land Acquisition Program, Council aims to acquire sites of the highest significance for nature conservation. The land acquisition program is funded by ratepayers, and since 1998 has secured over 3500 ha of land for protection in Council-managed conservation areas at a cost of around \$35 million.

A recent study found that 74 distinct vegetation communities are currently represented in the City's existing conservation network (Chenoweth EPLA 2009;

see also previous article by Francis and Bishop). These ecosystems provide habitat for a large number of highly restricted plants, including around 80 per cent of the entire Queensland population of Cunningham's Jute (*Corchorus cunninghamii*), approximately 25 per cent of the known population of the endangered Black Plum (*Pouteria eerwah*), one of only five known Queensland populations of the Small-leaved Tamarind (*Diploglottis campbellii*) and the most southerly and easterly known population of the threatened Plunkett Mallee (*Eucalyptus curtisii*). The reserves also provide habitat for locally endemic species including the Tamborine Zieria (*Zieria collina*) and Springbrook Wedding Bush (*Ricinocarpus speciosus*).

Acquisition of sites is based on their strategic value (for example in consolidating core habitat systems or providing connectivity between adjacent habitat remnants) and on conservation values (for example ecosystem diversity, vegetation condition, habitat for rare and threatened species, provision of ecosystem services, cultural heritage values and scenic amenity). Council's strategic and environmental planning unit carries out desktop and field assessments of each site proposed for acquisition. Sites are then scored, through a three-step filtering process, against a list of site selection criteria to determine a priority acquisition list.



Restoration site at Numinbah Conservation Area, showing site following weed removal (left) and regenerating native forest 8 months later (right).
Photos: Jen Ford.

This list is then used to direct land acquisitions, subject to availability of property for sale, value for money, available funds and stakeholder consultation (Gold Coast City Council, 2009b).

Vegetation condition and restoration

Whilst sites acquired through the levy contain a high proportion of intact remnant vegetation, some areas have been damaged or degraded as a result of past land uses. However, the level of ecosystem resilience (the regaining of structure and function post-stress) in these disturbed sites is generally very high. This ability of the native vegetation to recover has enabled Council to implement a successful restoration program covering over 500 ha spread across 212 reserves.

Revegetation is not necessary at the majority of Council's restoration sites, as the existing soil seed bank and adjacent remnant vegetation provide sufficient native seeds to regenerate following the removal of threatening processes. This saves significant funds and manpower. However, in order to ensure that the correct species for a particular ecosystem type are removed or retained, qualified and experienced practitioners are required to carry out restoration works.

The day-to-day management of Council's conservation estate is the responsibility of the Natural Areas Management Unit, which employs two teams of qualified bush regenerators with the skills and experience to analyse the resilience of a site and identify the level of resourcing required. These teams are funded by the Open Space Preservation Levy to work on Council's highest priority conservation reserves. By dividing their work between a number of sites on a fortnightly cycle, the restoration teams are able to achieve both economic and ecological efficiencies, carrying out vital follow-up weed control and maintenance in recently worked areas while continually expanding the extent of primary restoration works.

Case studies

The restoration program covers a diverse range of sites, each with a unique suite of characteristics that need to be considered in the planning and implementation of restoration works. Sites range from small urban remnants with limited connectivity and high levels of visitation, to

extensive tracts of native regrowth in the hinterland, often with difficult access and a history of agricultural use and inappropriate fire regimes.

Burleigh Ridge is an urban bushland reserve of approximately 25 ha that, despite its small size, is a significant element of one of the few remaining wildlife corridors in South East Queensland that links World-Heritage listed rainforest of the Border Ranges with the Pacific coast. For the last three years, a team of three professional bush regenerators has been restoring the site one day a fortnight. Floristic surveys carried out in 2006 indicated that almost 50 per cent of the area's plant species were exotic (Caddick, 2006). The area is degraded by major infestations of *Asparagus aethiopicus* (Ground Asparagus), *Ochna serrulata* (Mickey Mouse Bush), *Schefflera actinophylla* (Umbrella Tree) and numerous other weeds, many of which have colonised from neighbouring suburban gardens. Over 50 per cent of the site has now been restored to a healthy, self-sustaining system, and we anticipate that the entire site will be at this level in another 3-4 years, with only minimum maintenance required.

Numinbah Conservation Area covers 600 ha of land adjacent to the World-Heritage listed rainforests of Springbrook National Park. Past land use has left parts of it dominated by *Lantana camara* (Lantana), *Neonotonia wightii* (Glycine), *Ageratina riparia* (Mistflower), *A. adenophora* (Crofton Weed) and *Solanum mauritianum* (Tobacco Bush). Bush regeneration teams carry out weed control one day a week, including follow-up management of previously worked sites. To date over 60 ha of degraded land have been restored to young forests with a native tree canopy seven metres tall and a diverse understorey.

The future

The Open Space Preservation Levy Land Acquisition Program is a key action of Council's 2009-2019 Nature Conservation Strategy with a budget of \$20 million over the next five years. An additional \$26 million will be used to cover the operational costs associated with the restoration and maintenance of Council's conservation estate.

Council is also currently developing a number of strategic processes to systematically identify gaps in the conservation network and identify priorities for future land acquisition,

ecological restoration and other conservation management activities. GIS modelling of existing ecological and socio-economic data will enable allocation of Council's limited conservation budget to areas that are of the highest strategic value in terms of protecting, managing and restoring a diverse, connected and viable conservation network across public and private lands. This strategic approach is key to helping Council progress towards its Nature Conservation Strategy target (Gold Coast City Council, 2009a) of 'no net loss' of vegetation in 2019, moving to 'net gain' by 2040.

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Natural area planning in the Shire of Kalamunda, Western Australia

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Natural bushland comprises 74 per cent of the total area of the Shire of Kalamunda (Shire of Kalamunda, 2009). This substantial area of natural environment is extremely uncommon for a local government authority located geographically within close proximity to the Perth Central Business District. The Shire contains three distinctive landform types—the Swan Coastal Plain, the Darling Scarp and the Darling Plateau. Across these areas are national and regional parks, State Forest and a diverse array of reserves (Table 1), some containing locally endemic flora.

In recognition of the inherent need to protect and conserve these important vegetation complexes and other significant local biodiversity features for future generations, Shire officers have developed a Local Biodiversity Strategy. The Strategy aims to strategically plan natural area protection so that biodiversity conservation is incorporated into the Shire's planning and decision-making processes.

Developing a Local Biodiversity Strategy

Work on the Strategy commenced in August 2004 when Council resolved to participate in a pilot program facilitated by the Perth Biodiversity Project¹ to trial the use of Local Government Biodiversity Planning Guidelines to develop a Local Biodiversity Strategy. The Strategy was finalised in March 2009 when Council endorsed the document, and was consequently delivered to officers within the organisation and external stakeholders through a series of launches. In doing so, the Shire of Kalamunda became only the second local government in the Perth Metropolitan Region to complete a Local Biodiversity Strategy.

Undertaking the development of the Strategy has proven extremely valuable, as it has assisted the Shire to:

- identify the vast biodiversity resources contained within its natural areas,
- develop a vision for biodiversity conservation, and
- develop targets for the protection and management of natural areas.

The biodiversity resources within the district are contained within the administrative planning categories described in Table 1. Specific features within these categories include species recognised under the national *Environment Protection and Biodiversity Conservation Act 1999* and/or the state's *Wildlife Conservation Act 1950*. They comprise 14 species of Declared Rare Flora, 15 species of Threatened or Specially Protected Fauna and five Threatened Ecological Communities.

Local Natural Areas

Particular emphasis in the Strategy is placed upon the 2110 ha of Local Natural Areas. Shire reserves within this category were assessed using Natural Area Initial Assessment (NAIA) templates (Del Marco *et al.*, 2004) and this information was utilised to create a list of priorities. The Shire manages over 400 reserves of various types with varying extents of vegetation cover and condition, including water course, wetland and upland bush areas. Of these, 102 were identified as having biodiversity values and have been assessed using the NAIA templates. These reserves are scattered throughout the developed areas of the Shire, with a number of them adjoining the larger Department of Environment and Conservation managed estates.

¹ See article by Hamilton and Twycross, pages 30-31 in this issue

In order to develop effective tools to manage these natural areas officers from the Shire partnered with officers from the Perth Biodiversity Project to implement Local Government Guidelines for Bushland Management. They identified the best 20 reserves in the district and the major threats to their condition. Officers are presently in the process of formulating simple management action plans aimed at protecting and enhancing the inherent biodiversity values of these reserves.

Strategy targets

The vision statement defining biodiversity conservation is 'The Shire of Kalamunda will protect, manage and promote the social, economic and environmental values of biodiversity to ensure a lasting legacy for future generations' (Shire of Kalamunda, 2009). The statement was developed by the project's Steering Group and represents the long-term direction for local biodiversity conservation efforts and captures the broad opinion of the community.

Two specific types of feature targets, biodiversity and representational, were developed as part of the Strategy planning process with the aim of protecting and managing natural areas prior to impact occurring, primarily through development.

Biodiversity feature targets focus on protecting significant Local Natural Areas that contain biodiversity features or functions including:

- rare species and ecological communities,
- wetlands, waterways and associated riparian vegetation, and
- ecological linkages—maintaining ecological processes or natural systems.

An example of a biodiversity feature target proposed for the conservation of Declared Rare Flora is shown in Box 1.



Darling Range Ghost Gum (Eucalyptus laeliae) in natural bushland, Shire of Kalamunda. Photo: Murray Fagg.

Box 1. Proposed target for Declared Rare Flora (DRF) (Shire of Kalamunda, 2009)

Retain and protect natural areas containing DRF and provide and protect a buffer to the natural area containing the DRF. Where practicable, enhance these natural areas to maintain and improve biodiversity values.

Representational feature targets focus on retaining and protecting a proportion of each of the characteristic ecological communities found within the district. These targets are expressed as an area in hectares or as a percentage of the original vegetation extent. These targets also ensure that ecological communities that are characteristic of the district, and are therefore critical in providing the local community with a sense of place, will remain as an integral part of the district's landscape.

An example of a representational feature target proposed for the conservation of the regionally and locally rare Forrestfield vegetation complex is shown in Box 2.

Box 2. Proposed target for the Forrestfield vegetation complex (Shire of Kalamunda, 2009)

Retain and protect remaining areas of the Forrestfield vegetation complex's original extent, in good or better condition, within the Shire of Kalamunda. Formal protection will be increased by at least 10 hectares and preference should be given to retaining natural areas that also meet additional criteria, such as diversity, rarity and connectivity.

Conclusion

The Shire of Kalamunda will face many challenges with its aims of implement planning mechanisms designed to increase the level of protection of the local natural areas contained within the district. It will only be through the multiple undertaking of numerous and combined conservation actions that the proposed targets and hence the vision for biodiversity conservation in the district will be achieved.

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Table 1. Bushland extent within the Shire of Kalamunda classified by administrative planning category (Western Australian Local Government Association, 2007).

	Area (ha)	% of total
Total Natural Area	24,081	74
<i>Administrative Planning Category</i>		
- Bush Forever	293	0.9
- Conservation	9,144	28.1
- State Forest	11,064	34
- Regional Parks	1,465	4.5
- Local Natural Areas	2,115	6.5
Total Urban Area	8,273	26
Total Area of Shire	32,354	100



Shrubland vegetation, Shire of Kalamunda.
Photo: Murray Fagg.

A Local Government's use of resilience based mapping in ecological restoration, Queensland

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Background

The Sunshine Coast Regional Council uses resilience based mapping and natural area planning for 2000 ha of Council bushland reserves in the former Maroochy Shire.

Council needs a flexible monitoring system suitable for all its bushland reserves that produces valuable management and planning information, monitors condition and the effectiveness of works, *and* is affordable enough to cover all reserves and repeat as needed. The products must also be easily understood by decision-makers, community members, project partners, planners and workers.

Resilience mapping measures more than weeds and can be used across a range of vegetation communities, condition and disturbance regimes. It was found to be quicker than other methods and gave easily understood management information in maps and tables. Condition boundaries are set by what's on-ground, which is particularly useful where condition can vary dramatically across a small area.

What is resilience?

Resilience is the ability of a system to maintain a level of structure and function in the face of impacts and/or disturbance. Understanding differing levels and types of resilience can help understand why the same impact can have dramatically different consequences in two systems that appear the same.

Ecosystem resilience

The fundamental mechanism of ecosystem resilience is the ability of individual plants to resprout or germinate and progress towards a representative vegetation community.

Recovery after human-induced degradation generally requires assistance through weed treatment. And it is often unseen resilience—seed or propagules stored in the soil or elsewhere—that becomes apparent once weeds are treated. This response can be predicted with an understanding of 'recovery traits' of individual species persisting or pre-existing on a site, as well as knowledge of the likely response of the species after the degradation factors are corrected.

Relative to their resilience, one bushland area may respond quickly to the removal of an impact and rapidly regain structure and function, while another may require significantly more follow-up. The least resilient sites may even need propagule or plant re-introduction.

Mapping resilience

The surveyor first looks at the condition of the site itself—the *in situ* resilience—considering the absence or presence of recruitment and/or propagules of typically occurring species, structure and species composition, weed loads, natural hydrology, soils and past and present disturbances. The surveyor then looks for nearby or 'migratory' resilience, by searching for seeds and other propagules in nearby vegetation that could recolonise the site if there

is a vector to transport them. Having a good idea of the management history of the site is important for determining its true condition.

Bushland Services rolled out resilience mapping, called Bushland Operational Assessment, in December 2006, mapping 30 of our most significant reserves. With feedback from the mapped reserves and workshops, Bushland Operational Assessment evolved to its current form with seven criteria ranging from Excellent to Nil resilience.

Now approximately 95 per cent of the bushland reserves in the former Maroochy Shire are mapped. Bushland Operational Assessment data is collected through ArcPad™ software via GPS PDAs (Global Positioning System Personal Digital Assistants) and stored in Council's ArcMap™ system. Each condition area is mapped as a shape, with its condition class, percentage cover of the three main weed species and any other information as freeform notes. Management considerations such as neighbour impacts and biodiversity hotspots are collected as points.

Resilience mapping for natural area planning

Resilience mapping is part of the biodiversity component of the Reserve Significance Assessment (RSA). The quantified score ranks the reserve in comparison to other reserves, allocates resources according to value and explains to decision makers why we are working in this reserve (and not the one with all the resident complaints!). It determines how much new degradation will be accepted in a reserve, and how fast existing degradation should be restored—all working at the speed of the bush of course! The RSA score also determines how often a reserve is monitored.

The condition areas are used to develop management zones, breaking the reserve into areas of about the same level of the same types of work. Using the RSA score and the mapped resilience, the Good Bush Schedule (i.e. how fast this bush should become as good as it can be) is set, meaning that resources are allocated to reserves based on both their biodiversity value and need. This site-specific planning allows both accurate and optimal allocation of resources, or resource gap analysis as the case may be.

Work schedules and work instructions for each reserve are developed by reference to the management zones. These zones, being based on condition, allow accurate and clear description of the work needed in each area, and make contract management and inspections easier. The work schedule, instructions and reports are stored in our reserve database, meaning you can look at what work was done, where, over the years.

Communication

Feedback indicates that the Bushland Operational Assessment maps are a useful communication and education tool. Highlighting good patches of bush can

help emphasise that we want to *expand* the good bush into poorer areas, rather than just shrinking weed infestations. It can help deflect workers and community from the more obvious areas, and encourage the consolidation of better areas. We have found working from good bush to bad is much easier when it is both mapped and better understood by decision-makers and the community.

Monitoring

Repeat monitoring helps assess works' efficiency. If expenditure or effort is not being reflected by improvement over the years, Bushland Operational Assessment (BOA) gives the Council officer firm basis for review, redirection or reallocation. The BOA maps can help maintain community enthusiasm for regeneration with the greening of the map demonstrating the gradual improvement of condition that may not be obvious on-ground. Condition improvement can also be used as a target and measure.

Summary

As resilience based mapping depends on the skills of the mapper (rather than a quantified checklist) there is a level of subjectivity that we accept. However test runs on the same reserve mapped by different people have brought back pleasingly consistent results. And an overarching Bushland Operational Assessment is no barrier to using other survey methods where more quantified data is needed. But resilience mapping has meant that we have been able to affordably map all our reserves and then remap as required. Resilience mapping also informs the planning and management of our reserves and has met our baseline bushland condition monitoring needs.

Acknowledgements

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The Resilience Alliance <www.resalliance.org>

Aerial mapping of two riparian vine weeds in Tweed Shire, New South Wales

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Introduction

Tweed Shire covers an area of 1303 km² encompassing the whole of the Tweed River Catchment. The catchment, consisting of three main waterways—the Oxley River, the Tweed River and the Rous River—is surrounded by the Mt Warning (Wollumbin) caldera, which is part of the World Heritage listed Gondwanan Rainforest. The Shire consists of various vegetation communities, including the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) listed Littoral Rainforests and Coastal Vine Thickets of Eastern Australia Threatened Ecological Community. The Shire is home to 43 flora and 25 terrestrial fauna species listed under the EPBC Act.

Rainforests and Coastal Vine Thickets have been fragmented due to past sand-mining, urban expansion and clearing for agriculture. The riparian network provides important corridors for genetic exchange and movement of fauna, connecting component populations of rainforest and World Heritage areas.

The spread of introduced vine weeds in New South Wales is recognised as a key threat to the preservation of native

flora and fauna. Cats Claw Creeper (*Macfadyena unguis-cati*) and Madeira Vine (*Anredera cordifolia*) are regarded as the most severe weed threat to the environmental quality of waterways and riparian habitat in the Tweed River Catchment and are a serious threat to the biological diversity of the Shire. Their proliferation there is severely degrading some of the highest conservation value forest by smothering canopy and understorey and killing mature trees.

Cats Claw Creeper and Madeira Vine are native to South America and were introduced to Australia as ornamental plants. Cats Claw Creeper is a tuberous, woody climber with tendrils ending in sharp, hooked claws. Madeira Vine is a semi-succulent perennial that successfully reproduces from both aerial and underground tubers and will regrow from axillary buds still attached to leaf petioles (Big Scrub Rainforest Landcare Group, 2008). Both species are characterised by prolific flowering, rapid growth and effective dispersal within the riparian environment. They infest the canopy of native vegetation and can rapidly smother and kill mature trees, ultimately toppling them and creating gaps in the riparian corridor which leads to additional weed infestation. As a consequence, riparian zones become dominated by non-native species.

In July 2008, the Tweed Shire Council, with New South Wales Environmental Trust funding, contracted Ecosure Pty Ltd to survey and map the extent of riparian vine weeds in approximately 730 km² of the Tweed River catchment (see Ecosure, 2009).

The aims of this project were to identify and map the extent of Cats Claw Creeper and Madeira Vine infestations within the Oxley, Tweed and Rous rivers catchments. The primary purpose of mapping was to provide a framework to guide the preparation of a strategic plan for vine weed suppression at a strategic scale. It has enabled the identification and assessment of existing vine weed locations and set priorities for actions and resource allocation to effectively suppress these weeds.

Methods

Both Cats Claw Creeper and Madeira Vine are often interspersed within the canopy of native species and generally are difficult to discriminate from other vine species without close inspection. However, both species present distinguishing colour displays when flowering, and their *in situ* distribution can be estimated by mapping



Madreia Vine (*Anredera cordifolia*) smothering a *Casuarina cunninghamiana* tree. Photo: Ecosure Pty Ltd.

the extent of the flowers. Flowering periods vary between three and six weeks, but flowering may be asynchronous. Variations in flowering times are caused by elevation, aspect of habitat towards the sun, water and nutrient availability of each population of vine species. Flower retention may also vary with ambient conditions.

Observations from a helicopter were made when the vines were flowering and highly visible within the canopy of riparian vegetation. Most areas were surveyed at least twice during the flowering period to account for flowering variability. This method of mapping is the most effective means of covering large distances and negates the problems of passing through hard terrain, dense vegetation on the ground and gaining land owner permission to access private land. Helicopters also allow for a high level of speed and manoeuvrability that are ideal for surveying the terrain within the Shire.

Eight hours of ground surveys were performed for each target weed species, to ensure that the species mapped from the air as Cats Claw Creeper and Madeira Vine were correctly identified. Randomly located sites were also surveyed to confirm that there were no target weeds in areas that were mapped as 'no weed species being present'.

An ike 305 laser GPS (Global Positioning System) was used with an integrated 3.2 mega pixel camera, a 905 nm (invisible infrared) laser range finder (1000 m), a digital compass and an inclinometer (Survey Lab in New Zealand). This unit can capture positions remotely with offset positions calculated in real time. The unit was coupled with a Sokkia AXIS3 Differential unit that receives real time correction through the OmniSTAR Virtual Base Station system that allows for sub-metre precision.

The capture software used was an ike GPS version of GBM Mobile (MapInfo). It was customised as necessary to suit the project, allowing specific attributes of each weed to be captured in the field as meta data.

The patch size and relative density of each weed infestation was assessed and attributed to the location at the point of data capture. This delineation allowed the production of the maps, which illustrate the position, density and size of each weed patch. Different symbols were used to represent the size and density of weed patches within the catchment.

Results

During the aerial surveys, 521 ha and 172 isolated infestations of the target weeds were identified and mapped. Generally, both weeds occur on or near waterways with only a few patches found terrestrially as ornamental specimens in gardens.

Both of the target weeds are distributed throughout the three main waterways surveyed (the Oxley, Tweed and Rous rivers). The only waterways where the target weeds were not identified were tributaries to the Rous River. All other tributaries contain some level of infestation of the target weeds, although some only at the very downstream section where they join the main waterways.

Eight small patches of Madeira Vine and four small patches of Cats Claw Creeper were identified on the ground that were not seen from the air. These sites were not mature infestations, with the majority of the weed mass not having reached the canopy. This is a known limitation of aerial surveys where vines growing beneath the canopy may be shielded from aerial view.

Recommendations

The knowledge of the mature infestation locations gained through this survey will be an extremely useful tool that will aid the planning and management of future weed control programs. Key target properties will be identified for vine weed control with priority given to upper-most stream infestations of streams not heavily infested. Using this strategy, it may be possible to eradicate the vine weeds from small sub-catchments. When planning the strategic treatment of these weeds, consideration will also be given to the protection of areas of high conservation value.

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Flowers of the Cats Claw Creeper (Macfadyena unguis-cati) (top) and Madeira Vine (Anredera cordifolia) (bottom). Photos: Eddy Roberts (top) and Ecosure Pty Ltd (bottom).

Local government involvement in Western Australia's roadside vegetation management

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Roadside vegetation plays an incredibly important role in the conservation of Western Australia's unique flora and fauna. In heavily cleared landscapes, such as those found in the south-west where sometimes over 98 per cent of native vegetation has been cleared, it can form a significant proportion of the remaining vegetation. Roadside vegetation thus provides essential habitat for both flora and fauna. For example, over 50 per cent of the state's Declared Rare Flora have at least one roadside population, and four species occur only in road reserves, including one species that has just been rediscovered.

Western Australia has nearly 200 000 km of roads and road reserves, the majority managed by local governments. Most road reserves in the south-west are only 20.1 m wide, so there is a fine line in balancing the transport needs and safety of road users with conservation values.

Roadside vegetation has inherent problems for conservation. Edge effects, such as fertiliser drift and wind exposure, have a significant effect on roadside vegetation and are exacerbated by the simple act of road maintenance and the drastic results of road construction. The saying 'current management equals tomorrow's values' holds true for roadside conservation, as small changes in maintenance practices and careful consideration of construction projects can and do make a considerable difference in conserving biodiversity in road reserves.

While some local governments remain focused on the traditional 'roads, rates and rubbish', there has been a shift in attitudes both within the local communities and in local government staff. More and more local government engineers recognise the values of roadside vegetation and are therefore interested in conserving what remains. Local governments are however, constrained by ability, knowledge and resources, which makes the Roadside Conservation Committee's role in education and liaison essential.

Roadside vegetation conservation in action

Education is vital to conservation, particularly for people working on the front line of impact every day. Without an appreciation of what native vegetation is and why we should protect it, grader drivers will continue to 'tidy up that scrub' and care little for their actions. Without fail, training produces widened eyes and minds, a few exclamations of (positive) amazement and the inevitable



*High quality roadside vegetation, Shire of Coorow.
Photo: Cressida Wilson.*

healthy discussion on balancing needs. The result is a road crew who pay a little more attention to their surrounds and the impact of their actions.

Mapping roadside vegetation enables road managers to take appropriate action in areas with high conservation value vegetation. Produced by the Roadside Conservation Committee with the help of local community volunteers and local government staff, Roadside Conservation Value maps are prepared on a local government area basis for use by local government, Landcare groups and the public. Forty seven maps have been completed for shires in the south-west land division. These maps facilitate targeted weed control and strategic revegetation, and encourage the inclusion of roadside vegetation in planning shelterbelts and wildlife corridors.

The Roadside Conservation Value maps are also a useful tool in producing roadside vegetation management plans. These plans formalise management decisions, such as the use of different maintenance techniques according to conservation value. The maps and plans inform the planning of heavy haulage routes and the methods by which road upgrades are undertaken, as well as appropriate areas for revegetation and even fire management.

The Shire of Busselton, for example, is currently incorporating roadside conservation value scores into its traditional asset management database to enable

their inclusion when undertaking works. The Shire has decided to make vegetation a consideration along with traffic counts and accident history when planning road upgrades. The Shire of Dandaragan has been working with the West Midlands Group and the Roadside Conservation Committee to develop a management plan that incorporates vegetation conservation and more traditional road management approaches. The Shire of Serpentine Jarrahdale has been using the maps to inform road management actions for many years, with both Shire staff and community members passionate protectors of the Shire's roadside vegetation.

Conclusion

It is rewarding but challenging working with local government. On the one hand are positive results from training works crews and negotiating better outcomes on road works, but on the other is the attitude that road reserves are for roads and nothing else matters. From each local government, with its different approaches, abilities and community concerns, comes different opportunities. In spite of the setbacks and buoyed by successes, the Roadside Conservation Committee, the community and local governments continue to work for the conservation of roadside vegetation.

Defining and mapping an endangered ecological community within Lake Macquarie Local Government Area, New South Wales

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The Lower Hunter Spotted Gum – Ironbark Forest (the Forest) was originally defined and mapped as part of the Lower Hunter and Central Coast Regional Environment Management Strategy (NPWS, 2000). The community was subsequently recognised as an Endangered Ecological Community under the provisions of the New South Wales *Threatened Species Conservation Act 1995* (NSW Scientific Committee, 2005). Over 7800 ha of the Forest have been mapped for the Cessnock Local Government Area, which constitutes the core of its distribution (DECC, 2008).

Until recently the extent of the Forest was unknown within the Lake Macquarie City Council Local Government Area (Lake Macquarie Area), although it was modeled to occur there (NPWS, 2000). Survey and mapping projects, undertaken for proposed rezoning applications and development projects in the northern parts of the Lake Macquarie Area, revealed vegetation types that equated to this Endangered Ecological Community. In order to better understand the extent and composition of this community within its area of responsibility, the City Council commissioned a mapping project of the Forest in the Lake Macquarie Area, which complemented a regional review of the ecological community being completed for the state's Department of Environment, Climate Change and Water.

Defining the Forest

Since being listed as an Endangered Ecological Community, the Lower Hunter Spotted Gum – Ironbark Forest has

proven difficult to differentiate from similar vegetation in many areas of the Hunter Valley and Central Coast of New South Wales.

The original description of the community was based on multivariate cluster analysis of 95 full floristic survey plots, with the distribution centred on Cessnock but extending from North Rothbury to Maitland and Beresfield (NPWS, 2000). The Final Determination for the community states that it 'is dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus fibrosa* (Broad-leaved Ironbark), while *E. punctata* (Grey Gum) and *E. crebra* (Grey Ironbark) occur occasionally' (NSW Scientific Committee, 2005).

The co-dominance by *Corymbia maculata* and *Eucalyptus fibrosa* has been generally adopted by regional field botanists as the key floristic determining feature of Lower Hunter Spotted Gum – Ironbark Forest, and is the underlying feature behind a re-classification of the community. This rationale is supported by the range of environments where this combination of eucalypts dominates the vegetation, from the upper Hunter Valley in Manobalai Nature Reserve, to the coastal hinterland near Newcastle, as far south as Wyong, and north to the Karuah and Booral areas. This geographical range encompasses dramatic changes in geology and soil (Carboniferous, Permian and Triassic based), and with equally dramatic variations in rainfall (<700 mm/yr in the upper Hunter Valley up to 1200 mm/yr at Wyong). Clearly, a more refined description for the Forest, encompassing its many forms, is required to assist decision making and conservation planning.

Survey & mapping in Lake Macquarie Area

Knowledge of vegetation within the Lake Macquarie Area gained through previous studies, together with a broader appreciation of the influence of soil type and rainfall on vegetation types, dictated where the Lower Hunter Spotted Gum – Ironbark Forest may potentially occur.

Field inspections to collect field data for mapping purposes occurred within a broad area in the north-west of the Lake Macquarie Area. Previous fine-scale mapping of vegetation in much of the south-west of this area had not identified any of the Forest, so the south-west was excluded from further investigation. Areas found to support the canopy combination of *Corymbia maculata* and *Eucalyptus fibrosa* were mapped within Mapinfo© GIS. Over 600 ha of the Forest were mapped for the Lake Macquarie Area (Figure 1). On completion, full floristic sampling plots were censused within most stands of the Forest to better define its floristic composition within the Lake Macquarie Area, and to enable a comparative data analysis to be made with other stands elsewhere in the Hunter Region.

Data analysis completed to date has highlighted the importance of grass and herb species in differentiating between the various forms of Lower Hunter Spotted Gum – Ironbark Forest. In the Lake Macquarie area, a dominance of the grasses *Themeda australis* and *Joycea pallida* is characteristic. These species are replaced by *Entolasia stricta*, *Aristida vagans* and *Panicum simile* further inland around Cessnock. Lake Macquarie Area forms also tend to support a more open shrub layer, with fewer prickly shrubs. A closely related association, dominated by *Eucalyptus fibrosa* and the paperbarks *Melaleuca decora* and *M. nodosa* with very little *Corymbia maculata*, also occurs in lower slope positions.

Assisting a review of the Forest

Survey and mapping of the Lower Hunter Spotted Gum – Ironbark Forest in the Lake Macquarie Area has consolidated its spatial distribution there, and enabled collection of high quality floristic data to contribute towards a review of the community in the wider region. Map and floristic data can now be used for strategic planning purposes by the City Council, and will contribute to a holistic approach to protection of this Endangered Ecological Community within the Lake Macquarie Area.

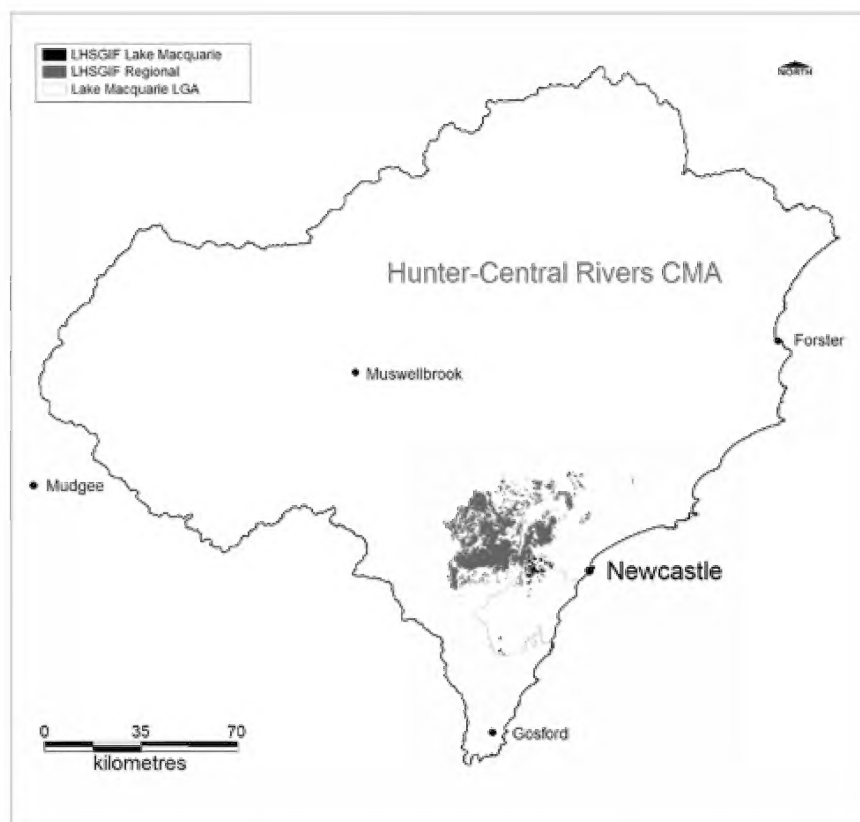


Figure 1. Distribution of Lower Hunter Spotted Gum – Ironbark Forest (NPWS, 2000 & current study).

Preliminary data analysis has highlighted the existence of a specific form of the Lower Hunter Spotted Gum – Ironbark Forest within the coastal zone, in areas where it has previously not been considered to occur. It is hoped that continuing survey and mapping will further clarify other geographical forms of this community, and that a revised description of the Forest will improve identification of the Endangered Ecological Community in the field.

Acknowledgements

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Native landscaping in the Redlands, Queensland

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Redland City Council (the Redlands) is one of the fastest growing areas in south-east Queensland, incorporating suburbs such as Capalaba, Birkdale and Alexandra Hills as well as more rural areas like Mount Cotton and Sheldon. Like many areas in this region the population of the Redlands is growing rapidly with a predicted increase of approximately 50 000 by 2026. Council has a growing network of environmental reserves with about 9500 ha of Council land being managed for conservation purposes. Many of the reserves are small, especially in the northern, more developed part of the city. In the more rural south however there are some significant areas of Council conservation lands, containing a range of different habitat types including threatened ecosystems.

The highly fragmented nature of the majority of these reserves has put them under enormous pressure, particularly from weed invasion. Many thousands of dollars are spent each year managing weeds—the majority of which are escaped garden plants—in our conservation reserves. Significant local environmental weeds include Ochna (*Ochna serrulata*), Easter Cassia (*Senna pendula*), Mile-A-Minute (*Ipomoea cairica*), Lantana (*Lantana camara*), Singapore Daisy (*Sphagneticola trilobata*) and Asparagus Fern (*Asparagus aethiopicus*). The long-term management of weeds in these reserves requires more than a long-term financial commitment to herbicide use. It requires a change of mindset by local residents as to what plants go into their backyards. Rather than wait for the next Ochna or the next Mile-A-Minute, Council decided to take a proactive approach and encourage the use of suitable plants in local gardens.

Redlands IndigiScapes Centre

In 2000 Council (then Redland Shire Council) opened the Redlands IndigiScapes Centre (IndigiScapes). It was named from *indigenous landscapes* and its core aim is the promotion of native plants in gardens—not just any native plants, but local native plants indigenous to the Redlands area. There are just over 1000 species of plants recorded from within this area (including North Stradbroke Island), and they provide a great palate to work with. To ensure the availability of these species a small volunteer nursery was set up to provide local species for sale to the public. All aspects of the nursery are overseen by volunteers, from seed collection and cleaning to propagation and sales.

Years of experimentation followed with some species adapting marvellously to cultivation and others less so.

Westringia eremicola and *Hovea acutifolia*, two local bushland species of debatable merits in the wild, have proved to be fantastic cultivated plants. Another example is *Hibbertia aspera*, an uncommon small shrub, which was propagated by cutting and then trialled in different locations with different maintenance regimes. Despite growing naturally in more sheltered sites, it soon became apparent that the species was best suited to sunny garden sites. It also proved a lovely small hedge species, flowering most of the year, and is now marketed as such in our nursery.

Demonstration gardens

The best way to promote local plants is to show what can be done with them, so a key part of IndigiScapes is a series of demonstration gardens along different themes. The aim of these is to show that a local native garden can be utilised without gardens necessarily looking like bushland. While some of us delight in a bushy garden, to introduce these plants to the non-converted it is essential to meet them halfway and show how local native plants can produce a similar look to many of the exotics. The gardens vary from structured and formal to quite informal, with varying levels of maintenance involved.

The Coastal Garden highlights species of the sand dunes, saline areas and littoral rainforest. We've been able to utilise well known plants such as Pigface (*Carpobrotus glaucescens*) and Paper Daisy (*Xerochrysum bracteatum*) while introducing less common species such as *Stackhousia spathulata* and *Leptospermum speciosum*. The Formal Garden provides an opportunity for mirroring, trellises, hedges and topiaries. Some plants are predictable (species of *Acmena* and *Syzygium*) and some less so (*Podocarpus spinulosus* and *Hibbertia aspera*). The Wild Herb Garden features plants with edible and medicinal uses, while the Rainforest Garden provides a nice, diverse haven and the opportunity to highlight important food plants (*Pararistolochia praevenosa*) and even endangered species (*Corchorus cunninghamii*). With more than ten different gardens, residents can usually find something that suits what outcomes they are after or what soil types they have.

The gardens are in two broad formats:

- smaller 'backyard' gardens for small spaces, that include fences, borders and more structures; and
- larger 'acreage' gardens with a less formal approach and that flow into one another without demarcation.

Using less water

The last 10 years has seen an enormous rise in the consciousness of water conservation in south-east Queensland and Australia more broadly. This has provided opportunities to promote local plants as real alternatives. Our display gardens have not been watered by sprinkler since 2003 and only new plantings are given water by buckets for a few weeks. Choosing the right species and creating the right microclimate has shown that utilising local natives can create a beautiful garden without the need for much water.

'Your Backyard Garden' program

The fragmentation of a landscape in an urban setting is a difficult thing to overcome and provides great impediments to the movement of urban wildlife. The urbanised area of Redlands is lucky enough to still have populations of koalas, greater gliders, squirrel gliders, flying-foxes and many bird species. The ability of these animals to move from one reserve to another is imperative to their long-term survival. It is not possible to recreate fully vegetated corridors through private properties, but it is possible to improve the habitat quality in those urban properties that form the 'link'.

A program called 'Your Backyard Garden' was initiated in 2004 to specifically target small landholders between reserves that would make a useful wildlife corridor. Residents who chose to partake in the program had a visit from a qualified extension officer. They were offered advice on improving their garden by planting local native species for wildlife habitat, managing weeds and potential future weeds and offered a free book and local native plants from the IndigiScapes nursery. Uptake of the program was strong.

Important corridors are now being targeted again with more resources available than before, including follow up visits and access to funding for larger projects. This careful targeting of resources will improve habitat links in the fragmented Redlands landscape, especially for more mobile species where a lack of habitat (not fences, pets and roads) is the major impediment to movement.



Two bushland species very successful in cultivation: Hovea acutifolia (top) and Westringia eremicola (bottom).

Photos: Craig Doolan (top) and Murray Fagg (bottom).

Making change happen

During the past 10 years there has been a significant, noticeable decline in the level of weed infestation in Redlands conservation reserves, especially in the more urbanised area. This can mostly be attributed to the work of many Council staff and volunteers eradicating weeds in the reserves, especially specific efforts against Singapore Daisy and Mile-A-Minute. The underlying cultural shift initiated by IndigiScapes and programs like Your Backyard Garden play an important role in preventing the continual re-infestation of our reserves with new weeds. I hope that in 10 years times I won't be writing the same things again, just with a new list of weeds.

A global tree conservation role for an International Arboretum in Canberra

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Introduction

In 2003 the bushfire that ravaged Canberra was the catalyst for the creation of an arboretum originally envisaged by the designer of the city of Canberra, Walter Burley Griffin. It has provided an opportunity to promote and in some cases conserve threatened species, and provides a valuable future resource in Canberra for ongoing education and research and a place for community recreation.

In December 2003 the ACT Government agreed that the burnt-out pine forest area known as Green Hills be redeveloped as an international arboretum. It is a 250 ha site near Lake Burley Griffin, about 6 km from the centre of Canberra.

Following a national design competition for a Canberra International Arboretum (the Arboretum), on 31 May 2005 the ACT Chief Minister, Jon Stanhope MLA, announced the landscape architects Taylor Cullity and Lethlean with the architects Tonkin Zulaikha Greer as the winners with their *100 Forests 100 Gardens* entry. As the name suggests, the design includes a series of forests, instead of the usual arboretum collection of individual trees or small clumps.

Tree conservation

An important aspect of the *100 Forests 100 Gardens* design concept was the focus on threatened and rare trees. This has provided an excellent theme in terms of the selection of the tree species and provided an opportunity to highlight the fact that many of the world's trees, often common in cultivation, are in fact threatened in the wild. For some of them, it will also help to protect them through *ex situ* conservation.

Overseas species

While the conservation of Australia's flora must still be seen as the priority for the majority of conservation programs in Australia, the work at the Arboretum takes into account the need to promote the importance of trees in a world-wide sense. Being the diplomatic capital of Australia, Canberra is well placed to fulfil such a role. Already a number of representatives from different countries have planted a tree that is indigenous to their country.

As a part of this, it is intended to look at presenting interpretation in languages other than English that are particularly relevant to where the trees occur naturally.

This could include an indigenous language where English is the national language.

At the individual species level, the Arboretum is also working with in-country and international conservationists. One example is *Cedrus libani* (Cedar of Lebanon). While the species is already in Australia and is reasonably easy to acquire, a closer link with the natural stands in Lebanon was sought. A contact at the Lebanese Agricultural Research Institute collected the seed at the Al Chouf Cedar Nature Reserve and the seed was passed on to the Arboretum via the Millennium Seed Bank in Kew. This has not only made other conservationists aware of the Arboretum but will also be an opportunity to promote the species and the Al Chouf Cedar Nature Reserve through the Lebanese Embassy in Canberra.

As some of the species that are being planted are endangered or even critically endangered in the wild, the amount of seed available can be limited. An example is *Sophora toromiro* which was endemic to the Pacific island of Rapa Nui (Easter Island) but is now extinct in the wild (Maunder *et al.*, 1999). As the Arboretum has not been able to produce a large enough number of plants for the total forest planting, it will share the forest lot with a 'host species'. In this case it will be *Sophora tetraptera* (Kowhai), a species from New Zealand, which will be planted with the *S. toromiro* and then slowly replaced as the latter is propagated. Such propagation cannot be done using seed collected from *S. toromiro* in the Arboretum as the genetic difference between species within the South Pacific is very low (Hurr *et al.*, 1999) and hybridisation is possible. Instead, vegetative material will be collected from across the *S. toromiro* planting of over 100 seedlings. However, testing of collections throughout the world indicate that the Arboretum's *S. toromiro* planting is still likely to have only a low level of genetic diversity (Maunder *et al.*, 1999).

Native species

Although the majority of the individual forests display an exotic tree species about 20 per cent are indigenous, including six threatened *Eucalyptus* species. In addition, a display of locally threatened and endangered species is being developed by the community-based group, Southern Tablelands Ecosystems Park and stands of *Corymbia maculata* and *E. tricarpa* are to be grown as research lots for the Australian National University.

Avoiding weedy species

One important issue that has been taken into account in selecting species for the Arboretum is their possible or recorded weediness. The CRC for Australian Weed Management's weed status list (Randall, 2007) has played an important role in plant selection. Several species meeting numerous of other requirements for the Arboretum have been rejected because of likely weed issues. However, this has not been an easy task as there may be substantial variation in the localities where plants have become weedy. As a result trees known to have been weedy in areas thought to be different to Canberra have sometimes been accepted. But the previous records must not be ignored and it is noted in Arboretum management plans that if a newly introduced species commences to show weediness that could lead to it becoming naturalised, it will be removed.

Testing species for local conditions

One of the roles of the Arboretum is to trial species in Canberra's conditions for horticultural use and for possible *ex situ* conservation in similar locations. This will include species that have not been grown in Canberra before, such as *Sophora toromiro* and species that have only been grown to a very limited extent, such as *Araucaria araucana* (Monkey Puzzle) and *Wollemia nobilis* (Wollemi Pine). While the genetic diversity of *W. nobilis* is exceptionally low (Peakall *et al.*, 2003) and the



Eucalyptus argophloia, less than one year after planting.
Photo: Adam Burgess.



Looking west across the Canberra International Arboretum. Photo: Adam Burgess.

opportunity to select particular forms is limited, there is enough landscape difference (e.g. aspect) on the forest site to show the impact of varying growing conditions on the health of individual specimens. The ongoing evaluation of such species' growth over time may also provide further evidence of climate change.

The future

Further information about the Arboretum competition and the winning design can be seen at <www.cmd.act.gov.au/arboretum>. It is planned that all of the 100 forests will be planted in time for Canberra's Centenary in 2013.

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Protecting the Western Australian Wheatbelt's natural assets

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Local governments have an important role in the conservation of remnant vegetation in the Central Wheatbelt region of south-west Western Australia. Many conservation strategies and management plans have been developed for remnant vegetation, community nature reserves, agricultural land and community parkland through these Wheatbelt councils. The strategies and management plans include working with the community and land holders to increase awareness of conservation practices, management of rare and threatened species and implementing conservation policy to ensure the best outcomes for the diverse environment of the Central Wheatbelt region.

Threatened species

The Matchstick Banksia (*Banksia cuneata*) is one of many rare and threatened flora species in the Central Wheatbelt region. Protected under the *Wildlife Protection Act 1950*, the species is restricted to the Quairading, Brookton and Cuballing shires. Increasing awareness of the species is essential, particularly in shires where the amount of remnant vegetation present is less than five per cent.

The Matchstick Banksia is currently being managed at two sites within the Shire of Quairading. They are a community park (Cuneata Park) in the centre of the Quairading town site and a local aboriginal community (Badjaling Wanderers Community) area on the town site's outskirts.



Banksia cuneata in flower. Photo: Department of Environment and Conservation.

The management plan for Cuneata Park was supported by external funding and included fencing and revegetation of companion plants. In addition, interpretive signs, benches and pathways were installed to increase community use of the park and increase awareness of the Matchstick Banksia and other native flora.

Community nature reserves

Community nature reserves play a significant part in local governments' responsibility to manage and conserve native vegetation. For example, the Quairading Community Nature Reserve is classified as a 'protected biodiversity asset'. Its management follows a conservation management plan initiated by the Friends of the Quairading Community Nature Reserve Committee with the assistance of the Quairading Shire Environment Officer. A covenant on the Nature Reserve has recently been implemented through National Trust Australia to ensure the reserve is conserved to a high standard.

The sustained quality of the Quairading Community Nature Reserve can be attributed to the exclusion of livestock and domestic animals and restricting visitors to designated walkways. A brochure on the reserve and interpretive signs were implemented to further promote the significance of flora and fauna present and therefore conserve the reserve's integrity. The south side of the reserve is currently not utilised at all for tourism purposes, and is used only by the local indigenous community to reflect on their cultural and historical values.

Planning and policies

Local governments have an important role in the management of threatened species and communities through the development of planning and land-use management policies.

The shires of Brookton, Beverley, York, Quairading and Cunderdin, collectively known as the South East Avon Voluntary Regional Organisation of Councils, developed a collaborative approach to tackling planning and land use management issues. They established the Planning and Land Use Management Group to target priority management areas and to develop consistency in policies for the region. Recently, the Group finalised a local planning policy on tree crops which has been implemented across the region.

The tree cropping policy aims to maximise the benefits and opportunities associated with tree crops, such as new

industry development and regional investment, while minimising any potential negative impacts. Tree crops have the potential to become an important land use in medium to low rainfall agricultural areas in Western Australia.

Management options for native vegetation on shire-owned land or privately owned farming properties are ultimately determined by the amount of available funding. Options may include fencing remnant vegetation, applying weed control strategies or pest management strategies.

Tackling the issues

Local governments play a vital role in the conservation management of native vegetation in the Wheatbelt region. Issues such as salinity, transient lifestyle blocks, wind erosion, reduced funding opportunities and progression of agricultural systems (trees being removed to make farming more efficient) are all examples of systems that affect plant conservation in the Wheatbelt of Western Australia. Local government organisations are working on these issues to ensure the best outcome for the conservation of plants and bushland areas into the future.



Weed control spraying in Quairading Community Nature Reserve. Photo: Emma Wilson.

Vegetation conservation programs in Hornsby Shire, New South Wales

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The 51 000 ha Hornsby Shire is known as ‘the Bushland Shire’. Stretching from Eastwood in the south to Brooklyn and Wisemans Ferry to the Hawkesbury River in the north, it features densely settled Sydney suburbs, villages set in bushland, semi-rural areas, large sand mines and extensive national parks with small river settlements. The local community values the bushland and the vast majority of residents (94%) are aware of Hornsby Council’s role in restoring and protecting it.

Council has adopted a Biodiversity Conservation Strategy (Hornsby Shire Council, 2004; 2006) to guide and implement its conservation actions. The broad aims are to conserve and restore biodiversity through knowledge and monitoring, incentives and partnerships, strategic planning, integrated bush regeneration programs, threat mitigation, conserving and restoring connectivity and other tactics.

With a lengthy interface between bushland and a large population in the developed areas, some of the most significant issues are bushland regeneration, bushland community programs, bushland recreation, native fauna, weed management, bushfire and planning instruments to conserve vegetation. This article focuses on Council’s programs for the first three of these issues.

Extent and types of vegetation

Nearly 70 per cent of the shire is covered by bushland on both public and private land. Of the publicly owned bush, 18 660 ha is managed by the National Parks and Wildlife Service (NPWS) and 2000 ha is managed by Council. Berowra Valley Regional Park is jointly managed by NPWS and Council. Berowra Valley is a dominant feature covering about 4000 ha and straddling large parts of the Berowra Creek catchment from Pennant Hills to Berowra Waters.

The Shire’s vegetation is characterised by three major geologies, the most predominant being the large areas of vegetation on the deeply dissected Hawkesbury sandstone occurring within national, regional and local bushland parks. The other main types are small patches of critically endangered vegetation occurring on the flatter ridges of the Wianamatta Shales, and endangered communities located on alluvial soils of the Hawkesbury river flats.

The most recent mapping of the Shire, excluding national parks (Smith and Smith, 2008) shows 34 native vegetation communities are present, including many forest types and several types of wetlands. Ten ecological communities (Table 1) are listed as threatened under federal and/or state legislation. Eleven regionally significant and four locally significant communities have also been identified.



A view across Berowra Valley. Photo: Hornsby Shire Council.

The three critically endangered forest types—Turpentine-Ironbark, Blue Gum Shale Forest and Blue Gum Diatreme Forest—have been cleared historically for rural and urban development. Of the Cumberland Plain vegetation, over 95 per cent has been cleared (Tozer, 2003). Hornsby Shire has about one quarter of all the remaining Turpentine-Ironbark Forest (295 ha of 1183 ha) and Blue Gum Shale Forest (37 ha of 169 ha), and possibly all the remaining Blue Gum Diatreme Forest (14 ha).

Eighty-nine per cent of the Shire's endangered plant communities have been found to occur on private land with only 58 ha occurring on public land (Lembit, 2002). Most critically endangered vegetation was in fragmented patches averaging 1.6 ha in Council reserves, school grounds, several monasteries and backyards. Many of these small patches are highly modified and threatened by weeds and mowing.

Bushcare

Hornsby Council's Bushcare program has just celebrated 20 years of on-ground work. Today over 850 registered community volunteers work on 119 sites to conserve and rehabilitate publicly owned natural bushland.

Training is an important part of Bushcare. Volunteers work on-site with a professional Bushcare trainer to learn plant identification and weed control skills, and can attend several TAFE accredited courses offered through Council. Site tours and seminars explore topics such as creeks, converting backyard pools into ponds, frogs, threatened species and common birds. A youth outreach is being rolled out through TAFE and local university expos. Bushcare also assists local schools in restoring bushland in their grounds and has trained staff and students.

Several Bushcare groups receive environmental grants. One example is the 'Catchment Connections Grant' with Ryde and Hunters Hill councils involving eight groups along Terrys Creek. Another is the Roselea group who

successfully obtained an Envirofund Grant and used contract bush regenerators to clear noxious weeds, and hand terrace and plant a highly degraded creek bank. A sponsorship from Transurban Hills M2 assisted the work of the Chilworth bushcare group, and created the new 'Beecroft-Chilworth Link Track' as well as closed some inappropriate tracks.

Community Nursery

In addition to providing plants for Council bush regeneration sites, landscaping and stormwater remediation works, the Community Nursery also supports local landholders who are regenerating and revegetating their properties. One example is the Benedictine Monastery Arcadia where seed collected from the Turpentine-Ironbark forest was propagated and planted by the monks together with Bushcare and nursery volunteers. A major part of the nursery program is the regular four plant giveaways per year, providing residents from specific suburbs with provenance plants.

Council has 40 regular nursery volunteers who produce over 40 000 provenance plants each year. The nursery recycles all water on site and was the first council in New South Wales to receive accreditation under the Nursery Industry Accreditation Scheme Australia. This year Council doubled its propagation area.

TAFE and other classes use the Hornsby Nursery for teaching purposes, and an exchange program is held with the Fairfield Community Nursery which propagates plants for Cumberland Plain woodland remnants.

Information and access

Council publishes several informative guides on native plants: *Weeds and Native Look-Alikes*, *Gardening with Native Plants* and the more detailed *Indigenous Plants for the Bushland Shire*. A deck of educational playing cards, featuring suits based on threatened flora and fauna, vegetation communities and bushland reserves, has provided a different way of presenting biodiversity awareness and information.



*Participants in a guided bushwalk.
Photo: Hornsby Shire Council.*

Table 1. Threatened ecological communities in Hornsby Shire listed under the Australian Government Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the New South Wales Threatened Species Conservation Act 1995 (TSC Act) (derived from Smith and Smith, 2008).

Ecological community	Status	
	EPBC Act	TSC Act
Turpentine-Ironbark Forest	Critically endangered	Endangered
Blue Gum Shale Forest (a form of Blue Gum High Forest)	Critically endangered	Critically endangered
Blue Gum Diatreme Forest (a form of Blue Gum High Forest)	-	Critically endangered
Shale/Sandstone Transition Forest	Endangered	Endangered
Duffys Forest	-	Endangered
River-flat Forest on Coastal Floodplains (mapped as two subforms: Rough-barked Apple River-flat Forest, and Forest Red Gum River-flat Forest)	-	Endangered
Shale Gravel Transition Forest	-	Endangered
Swamp Oak Floodplain Forest	-	Endangered
Coastal Saltmarsh	-	Endangered
Swamp Sclerophyll Forest (mapped as three subforms: Swamp Mahogany Forest, Floodplain Paperbark Scrub, and Floodplain Reedland)	-	Endangered

A free guided bushwalks program for residents engages people with the bush to learn about the local flora and fauna. Professional guides lead participants through well known and new tracks, and offer a variety of activities such as spotlighting for kids, nature photography and bird tours of wetlands. In a typical year over 35 walks are held with about 800 participants.

In addition to the wide variety of walking tracks already available, new tracks are being investigated and developed, including links to the Great North Walk, restoration of Depression era steps, and the potential for mountain bike tracks.

Contract Bush Regeneration Program

Council has engaged the services of bushland restoration contractors since the early 1990s to systematically remove weeds, allowing native plants to establish. As one of Council's major bushland programs, around half a million dollars are expended annually at over 50 sites to enable manual, chemical, mechanical, biological and fire treatments over the long-term. Strategic criteria ensure that the funds are expended where they will have the greatest conservation benefit.

Private property programs

Several private property programs have been adopted and developed by Council for urban, rural, school and monastery properties to manage and conserve significant bushland. The programs are based on providing training and skills, developing a restoration plan for the site, and professional assistance and support for bush regeneration. Since 2003 many residents have participated in Council workshops and rural property planning courses. They have benefited from the technical advice and support as well as gaining incentives such as assistance with bush regeneration, subsidised materials, fencing and plants for their properties. A new program is focussed on restoring habitat connectivity across the Shire.

Reaching out with 'Greenstyle'

Greenstyle is a new, integrated program helping busy residents not previously involved in environmental activities to achieve sustainability in their home and garden. It is run jointly between Hornsby, Kuring-gai and Willoughby councils with assistance from the New South Wales Environmental Trust. In Hornsby Shire, 136 participants have joined the program for an assessment in the past year. Of these 14 per cent are from non-English speaking backgrounds.

The program promotes biodiversity conservation on private property and assists residents in home sustainability. The target participants are the time-poor 25-55 year age group, especially those living adjacent to bushland and creeks. The program offers in-home assessments, an information kit and detailed advice, discounts from local 'green' businesses, a website, free native plants and training events.

More than 1500 residents who were unfamiliar with the benefits of a native garden received plant vouchers, and more than 900 of these have claimed provenance plants from Council's Nursery to plant out. The new Lower Dartford bushcare group has commenced as a result of Greenstyle. Most (66%) had not previously been involved in a council environmental program and are now more able to improve sustainability in their homes and gardens.

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Plant conservation in the Australian Capital Territory

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Of the 240 000 ha that make up the Australian Capital Territory, 54 per cent is protected in national park and nature reserve. Despite this impressive protected area estate, like all jurisdictions, the Territory has threatened species and ecological communities within its borders. The Territory has eight plant species and two ecological communities listed as threatened. This article provides a brief overview of the challenges for their conservation and a snapshot of the Territory's communities and species that face a precarious future.

Threats to native plant conservation in the Territory

The key threats to plants in the Australian Capital Territory include inappropriate fire regimes, competition from pest plants and animals, land use change, urban edge effects, and climate change. Population growth and the expansion of the city into 'greenfield' areas is where the greatest tension lies between conservation and urban development. Undoubtedly, local governments everywhere are facing similar tests.

Threatened ecological communities

Woodlands and grassland communities were once extensive, covering the rolling hills and river valleys of the Territory lowlands. Now the challenge is to maintain and improve the health of the remaining patches and the viability of their dependent species.

Yellow Box-Red Gum Grassy Woodland

Although containing only a relatively small area of box-gum woodland (around 12 000 ha), the Territory has some of the best quality and largest stands remaining in the Southern Tablelands bioregion. Thirty-four per cent of the Territory's pre-European extent of this woodland remains today, with around 30 per cent protected in nature reserve.

The Territory Government is collaborating with the Australian National University and other partners on a long-term research project to learn about rehabilitating Box-Gum woodlands. The research is testing a range of management strategies to rehabilitate modified woodland. Treatments include adding dead wood, assessing the effects of fire, kangaroo grazing control, vertebrate pest eradication, and the reintroduction of species that have become locally extinct.

Natural Temperate Grassland

Canberra has been built in a landscape that once supported 20 000 ha of Natural Temperate Grassland that is now diminished to 1000 ha in fragments across the Territory. Only five per cent of the Territory's original pre-1750 Lowland Natural Temperate Grassland remains. The grasslands are generally sited in and around the urban area of Canberra, which presents a range of management issues relating to urban edge effects.

Threatened plant species

Of the eight threatened plants listed under Australian Capital Territory legislation, all are extremely rare and five of them are found only in the Territory. Plants that have such limited distribution and very small populations present a conservation challenge. It is difficult to research their ecology and generate sufficient knowledge to make informed adjustments for the management of sites where they occur. *Ex situ* conservation measures, where feasible, are essential for their long-term survival.

Gentiana baeuerlenii

Gentiana baeuerlenii is a small subalpine herb that occurs only in Namadgi National Park. It was recorded near Bombala in New South Wales in the 1890s, but is now presumed extinct there. The species appears irregularly in late spring or early summer, and grows between the tussocks of moist tussock grassland and sedgeland. No plants have been found during annual monitoring in the last five years; the dry conditions may be contributing to its absence.



Gentiana baeuerlenii flowers. Photo: Murray Fagg.

Brindabella Midge Orchid (*Corunastylis ectopa*)

This beautiful orchid species is found only in the Territory from one location in a road cutting in the northern area of Namadgi National Park. The site is monitored annually. Only five plants have been recorded and despite searching for other populations, none have been found.

Ginninderra Peppercress (*Lepidium ginninderrense*)

This obscure species was discovered in 1994 on Defence land at the Belconnen Naval Transmission Station near the shores of Lake Ginninderra in Canberra. At the time 40 plants were recorded, and under Defence management the population has steadily increased to 1137 plants. The Australian National Botanical Gardens has collected seed from the plants for storage to act as a core for *ex situ* genetic conservation. Plants have also been grown from seed to enable the potential establishment of new populations in suitable locations.

Tarengo Leek Orchid (*Prasophyllum petilum*)

Extant in only two locations, one each in the Australian Capital Territory and New South Wales, little is known about the specific ecology and management requirements of the Tarengo Leek Orchid. The small population at the Hall Cemetery in the north-west of the Territory has been monitored since 1991. The population appears to be slowly increasing in abundance despite often dramatic fluctuations, and at last count totalled 90 plants.

Tuggeranong Lignum (*Muehlenbeckia tuggeranong*)

Tuggeranong Lignum is a wiry, sprawling, sexual phenomenon. It is a unisexual shrub with cream-green unisexual, or occasionally, hermaphrodite flowers. It was described from a single female plant and six male plants discovered in the Murrumbidgee River Corridor near Tuggeranong on the outskirts of Canberra in 1997. This single wild population appears to have remained unchanged. The Australian National Botanical Gardens has successfully grown many specimens from cuttings with a view to establishing new populations along the Murrumbidgee River.

Canberra Spider Orchid (*Arachrorchis pengilleyi*)

The Canberra Spider Orchid is currently known from only three small populations in the Territory, collectively comprising over 200 plants. At one site the plants have not been seen for a number of years although it is monitored annually. The other populations appear to be stable but are impacted by rabbit and kangaroo grazing. A draft management plan has been prepared and in the coming months the known sites will be fenced off to exclude these herbivores.

Small Purple Pea (*Swainsona recta*)

The Small Purple Pea was relatively widespread but over the past 60 years its known range has drastically decreased to small fragmented populations in New South Wales and

the Australian Capital Territory. Fewer than 4000 plants now survive at five known sites in the Territory, the largest of which is in the Mount Taylor Nature Reserve where 94 plants were recorded initially.

In 2009 every site in the Territory was inspected; no plants were found at three of the five sites. One site with a small population remains stable, while the main population in the Mt Taylor Nature Reserve is healthy and stable with over 200 individual plants recorded. There is low annual mortality of adult plants but the recruitment of new plants appears to be slow.

Button Wrinklewort (*Rutidosia leptorhynchoides*)

The Button Wrinklewort is a slender perennial, multi-stemmed forb that was once widespread across the western plains of Victoria, and south-eastern New South Wales. There are 25 known locations remaining in New South Wales, the Australian Capital Territory and Victoria. Of the nine sites occurring within the Territory, the largest is literally a stone's throw from Parliament House, where close to 70 000 plants have been recorded. One other large site comprises about 30 000 plants.

The Territory populations appear to be stable but are potentially under threat by future urban development. The Territory Government plans to trial the reintroduction of Button Wrinklewort into a grassland nature reserve to assist in the conservation of the species.



Rutidosia leptorhynchoides plant. Photo: ACT Parks, Conservation and Lands.

Further information

Action plans for these ecological communities and species can be obtained via the website <www.tams.act.gov.au/play/parks_conservation_and_lands/conservation_and_ecological_communities>.

Dealing with complexity: integrated natural resource management, local government and biodiversity conservation in the Perth region

Bruce Hamilton and Lindy Twycross

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The short history of *Homo sapien's* interaction with the environment is a tragic story. We have destroyed much of the environment and disrupted ecological processes to the stage where we are facing world wide changes. Why has this happened?

One cause is that we found nature hard to deal with because of its complexity and abundant, seemingly endless natural resources that we could exploit. So we developed institutions including religion, education, industry and government to conquer, divide and exploit nature. The results have been catastrophic.

Only recently have we started to understand that we need integrated and coordinated approaches to deal with the complex problems and issues facing the natural world and the impacts on the quality of our life. This is extremely difficult, because we have to counter over 2000 years of culture, behaviour and institutions that have been developed to exploit nature, and researchers tell us that these are very hard to change.

Perth region model

Perth Region Natural Resource Management (NRM) is the fourth most populated of the 56 natural resource management regions in Australia. Its business model involves bringing all the relevant stakeholders together to achieve a jointly agreed landscape vision, that includes goals and high level targets. The Vision is:

The natural resources of the Perth region are protected and managed for ecological sustainability for the enhancement of the quality of life of present and future generations.

Perth Region NRM has 12 theme and geographic reference groups that bring around 180 stakeholders together to develop business plans to reach goals and high level targets that will jointly achieve the vision. The intention is then to link our overall natural resource management business plan to other Australian, state and local government business plans plus those of industry to jointly achieve the best value for all natural resource management investments.

National and state natural resource management objectives and targets are built into this regional approach so that true integration is achieved. The economic driver for this approach is the fact that public funds for environmental protection and management are limited, so they must be

invested in the most cost effective manner. For example, it is estimated that the State and local governments annually invest over \$150 m and \$250 m (respectively) in natural resource management in the Perth region, compared to \$2.3 m of Caring for our Country funding through Perth Region NRM. If all of these funds are co-invested, along with community initiatives, much can be achieved. We can look more broadly than just at the 'high priority' assets, such as endangered species and threatened ecological communities.

Local Government as full and valued partners

Given that Local Government is the biggest natural resource management investor in the Perth Region, it is important that Perth Region NRM creates partnerships with the 30 local governments in the region. It does this through a high level Local Government Reference Group that brings mayors, councillors and CEOs together with five geographic reference groups (that each brings community groups and local government officers together) for on-ground action. This group fits closely with Local Government, as it is the 'sphere' of government nearest to the people, with a broad charter to manage a wide range of activities across landscapes and communities.

In order to maximise Local Government investment in natural resource management, case studies were carried out to determine the best models for a more consistent and transparent approach. The resulting report *Integrating NRM into LG Core Business* was released in January 2009 and contained 19 recommendations for individual local governments and six for regional ones. They cover:

- Leadership and organisational structure
- Statutory and strategic planning, natural resource management strategies and policy
- Resource allocation and strategic management plus financial reporting
- Definition of natural resource management
- Internal coordination
- Natural resource management/environmental officer or coordinator
- Community engagement and information
- Education and training
- Strategic direction and coordination by regional local governments.

The recommendations are being tested with the case study local governments and seven others not involved with the report to see if they are practical and would be implemented. They will then be taken to the remaining local governments in the region for full implementation.

Influencing the planning and development process

The Western Australian Planning Commission recently released a planning framework for the future development of the Perth and Peel region, titled *Directions 2031: Draft Spatial Framework for Perth and Peel*. A key part of it is the concept of a 'green city' with a sustainable 'green network' underpinning future economic and social well being.

Perth Region NRM has for some time been promoting the idea of 'integrated landuse planning' as a key tool to incorporate its natural resource management vision for the region into the statutory planning and development process. Our thesis is that if we can identify all of the 'natural' areas that we want to keep for the well being of future generations and the areas suitable for development, we can work together to create the landscapes and communities we want.

The Planning Commission is now testing 'sustainability mapping' as a tool to prioritise areas for development and conservation at a regional scale, so there is now real hope that we can conserve and manage the natural assets we want to keep.

Perth Biodiversity Project

Local governments have the potential to significantly impact on the region's rich and unique biodiversity through their land use planning powers as land managers and through links to local communities.

The Perth Biodiversity Project, managed by the Western Australian Local Government Association, assists local governments in the region to take a strategic, consistent and recognised approach to biodiversity conservation planning across private and public lands outside the regional reserve system. It provides various tools and services to increase their capacity to improve biodiversity conservation, facilitating a phased planning process that culminates in the preparation and implementation of a Local Biodiversity Strategy.

The local biodiversity planning process has been designed to provide a recognised tool that helps to meet environmental objectives of Local Government and to assist with integration of biodiversity conservation objectives into a local planning framework through local planning strategies and schemes. It also assists with strategic on-ground management of natural areas and in developing ecological linkages including streetscapes with appropriate plantings. An associated Local Biodiversity Strategy Action Plan includes development of a local planning policy for biodiversity conservation, strategic action plans for council reserves and an incentives strategy to encourage private landowners to manage biodiversity resources.

This rigorous local biodiversity planning process builds on ecological criteria recognised at the state level and aims to support a network of regionally significant natural areas through identification of Locally Significant Natural Areas and opportunities and constraints for their conservation. Local communities are engaged in all stages of Local Biodiversity Strategy preparation to ensure that the council's vision represents their communities.

The resulting model for conservation planning at a local level demonstrates how biodiversity protection can be developed within a linked hierarchy of protection that connects across the landscape, across each community and with consideration of all administrative levels.

Conclusion

We initially commented on how hard it is to conserve and manage natural resources in a holistic way. We have presented a set of interlinked models for integration and working together, including a city based community natural resource management group and 30 metropolitan local governments, building natural resource management into statutory planning and practical processes for conserving biodiversity at local and regional scales. Natural resource management is hard to do, but by working together at different levels and in different ways we can achieve a lot.

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Why local government is a minor player in plant conservation in South Australia

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Introduction

Effective plant conservation requires good local knowledge and a long-term commitment to detailed site management. Local government is potentially best placed to provide this because councils already know their districts and are closest to the people. But local government generally performs badly in the area of plant conservation and the reasons are complex. Comments here are necessarily generalisations and I intend no criticism of any particular council.

I work for the City of Burnside but this article does not necessarily reflect the views of the council or the community of Burnside.

The present role of local government

Local councils in South Australia exist under the *Local Government Act 1999*. With delegated powers under this and other acts of parliament, councils have control over reserve management, fire prevention and private development.

Since 1985, vegetation clearance controls have obliged councils to consider native vegetation in the maintenance of roadsides and reserves, and vegetation clearance must follow a plan approved by the Native Vegetation Council set up under the *Native Vegetation Act 1991*. Over the years there has been a gradual loosening of regulations, and there is no vegetation protection in metropolitan Adelaide and very little in residential areas outside it.



Peri-urban wetland restoration site managed by well supervised volunteers, Waterfall Gully Reserve, City of Burnside. Photo: A Crompton.

In 2008, the Native Vegetation Working Group of the Local Government Association produced a report with 16 recommendations. These mostly aim to expedite native vegetation clearance and streamline development by, for example, removing clearance restrictions in areas zoned urban, commercial and industrial. The committee's report shows that plant conservation is still generally of little concern to councils.

It is mainly in metropolitan Adelaide (where native flora has been almost completely lost) that councils have shown some practical interest in nature conservation. Each council has developed its program in different ways in reaction to different circumstances. For example, the City of Burnside set up a biodiversity program as part of its response to the 1992 Rio Earth Summit; the City of Mitcham set up a land management program in response to concern about fire hazard in its reserves; and the City of Adelaide set up a biodiversity program to manage large scale plantings in the Adelaide parklands which arose from the state government Million Trees Program. These and several other metropolitan councils have conservation and land management field teams or at least technical officers with the responsibility of organising contractors to do land management work.

Outside the metropolitan area, performance is generally poor. The prevailing attitude is that native vegetation management is irrelevant to the role of council and that voluntary flora conservation work on reserves is simply an alternative recreational use. Plant conservation work directly undertaken by councils generally occurs through the enthusiasm of staff and their willingness to do things that are not strictly in their job description.

The *Natural Resources Management Act 2004* set up an agency for land management to which councils are mandated to contribute funds. Section 7(1) of the act states

the local government sector is to be recognised as a key participant in natural resource management, especially on account of its close connections to the community and its role in regional and local planning.

And section 7(3) states that

In performing its functions, the NRM Council should seek to work collaboratively with...local government.

Despite these statements in the act, there is not a strong relationship between natural resource management boards and councils. Neither is the potential role of

local government recognised by other state government departments and agencies. The state government biodiversity strategy *No Species Loss* pays little attention to the role of local government in plant conservation. Most council managers reading this plan will see nothing in it for them.

Can plant conservation have a higher profile in local government?

Elected members and staff in both levels of government as well as the community all have a role to play in realising the potential for local government in plant conservation.

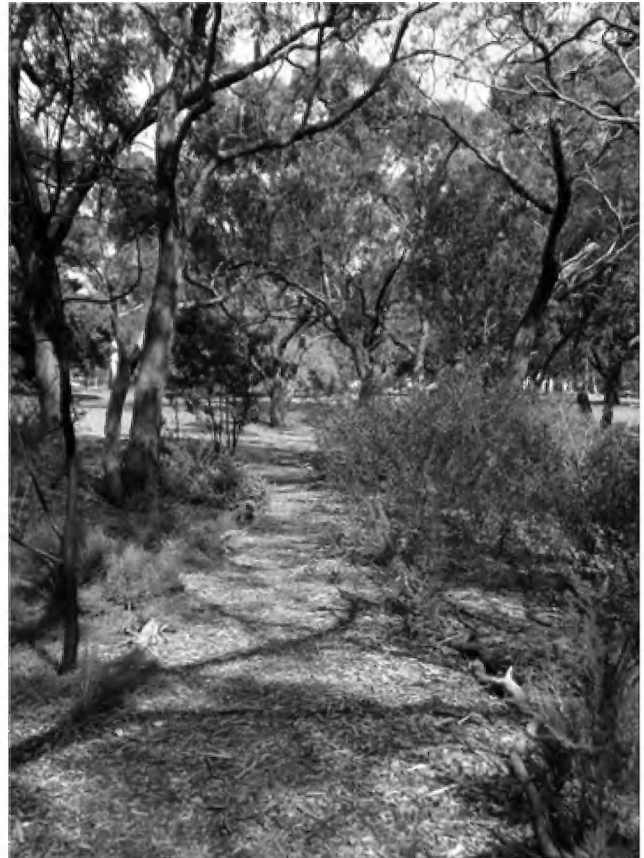
On rare occasions there may be enough environmentally and scientifically aware elected members to implement good policy and practice. This occurred in the City of Burnside in the 1990s when a comprehensive local environmental plan was developed, resourced and implemented. The local biodiversity program resulting from this plan has become an ongoing part of council practice and has provided a precedent for local urban biodiversity programs in other council areas.

Senior management staff are most aware of the legal responsibilities of councils and have the greatest influence in implementing changes to legislation about vegetation management. Senior managers are also vital for communication down from council and up from technical and field staff and the community. Local plant conservation programs rely on senior management who are open to new ideas and can work at a high level to forge the linkages across agencies that are hinted in legislation but not mandated.

All urban and peri-urban councils have at least one technical staff member responsible for plant conservation. In 2005, technical staff formed the Local Government Biodiversity Officers Network to share experiences and to discuss topics of mutual interest. A common theme in the network is the lack of support from senior management and elected members for flora conservation. The local Vegetation Marker Scheme developed by the network has recently been promoted by the Local Government Association. This is an example of technical staff working together to raise the profile of plant conservation in councils.

Many improvements in local biodiversity conservation practice have come through community action, either from grass-roots activists influencing policy or the practical on-ground voluntary work of friends groups. Volunteers make the greatest difference if they are well trained and supervised. The Burnside Biodiversity Volunteers, supported by the City of Burnside, is an example of this.

Examples from individual councils, from individual staff members and from the community provide a glimpse of the potential that exists to transform plant conservation practice in local government. It is likely that these will remain as isolated examples unless the role for local



*Urban woodland restoration site managed by experienced council field staff, Beaumont Common, City of Burnside.
Photo: A Crompton.*

government is recognised by state government and steps are taken to ensure that all councils have a botanically and technically competent biodiversity officer, a biodiversity plan and the resources to implement it. This can happen by amending acts related to conservation so that natural resource management is part of local government, not separate from it.

Conclusion

Given the present push to 'build a big Australia', there is unlikely to be any legislative incentive for local government to take responsibility for local plant conservation. So in the absence of any top down reform it is clear that reform must happen from the bottom up. The conclusion, then, is simple. Council staff need to work with their communities to develop quality conservation sites to provide examples to community, senior staff and elected members. Council staff also need to work with state government agency staff and non-government organisation to ensure that all natural resource management activity in their district maximises interaction with the council and works on local priorities. Positive reports to council of community engagement and good local publicity are still probably the best way of encouraging elected members and senior managers to support plant conservation programs.

ANPC in the USA

Zoë Smith

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I am currently a postdoctoral fellow at the Smithsonian Environmental Research Center, Edgewater, Maryland, USA. This regular report covers some of my experiences in environmental research in the USA and provides recent highlights in science and conservation there. An introduction to this regular report and background on the Research Center can be found in the September–November issue of *Australasian Plant Conservation*.

Fall and festivals

My first experience of a real Fall was quite breathtaking as I undertook fieldwork in the Appalachian mountains between New York and West Virginia. Characteristic deciduous canopy species including Tulip Poplar (*Liriodendron tulipifera*), White Ash (*Fraxinus americana*) and Yellow Birch (*Betula alleghaniensis*) shed their leaves in a vibrant array of ochres and tans, although the fluorescent Red Maple (*Acer rubrum*) stole the show. Among all the colour it was difficult to spot the deer hunters, all decked out in army style camouflage attire for the two month hunting season. Even when the bugs have stopped biting and the bears are asleep, one must still take every precaution in the woods to prevent being mistaken for game. Interestingly, deer have become so populous in some areas that culling is necessary to protect vegetation (including some of my study orchid populations). I'm not sure that everyone here really believes me that kangaroos are having the same effects in parts of Australia.

Deer are not the only prey at this time of the year, with thousands of turkeys being lined up in supermarkets ready for Thanksgiving and Christmas. Carved faces of Halloween pumpkins are only just starting to sag as they are replaced by spectacular lighting displays, and lawn graveyards and ghouls are replaced by plastic reindeer cutouts. There is certainly no shortage of festivity.

Vegetation changes in the Appalachians

The Appalachians comprise a system of mountain ranges in eastern USA and south-eastern Canada, extending northeast from central Alabama to the island of Newfoundland. Individual mountains reach an average altitude of 900 m, with a maximum of about 2000 m in North Carolina. Working and hiking throughout the ranges has revealed some interesting recent changes in the vegetation. Rapidly expanding urban development has markedly altered the hydrology of some areas in the foothills, reducing permanently inundated bogs to reticulate streams. Invasive species are also causing rapid vegetation changes. For example, the Hemlock Woolly Adelgid (*Adelges tsugae*), a sap-sucking insect introduced from East Asia in 1924, has caused widespread mortality of the eastern hemlock

(*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*). Similarly, the Eurasian Gypsy Moth (*Lymantria dispar*) has caused extensive defoliation of forest trees, particularly pines and hemlocks, and is now one of America's worst forest pest insects. Japanese stiltgrass (*Microstegium vimineum*) is also commonly found in forests of north eastern USA, its movement facilitated by deer and human soil disturbance. Previous clearing of forests for agriculture has modified the dominant canopy species although forest cover appears to have remained relatively stable over the last hundred years. Periodic fires have had an important influence on vegetation composition in the Appalachians, particularly in maintaining oak dominance before European settlement. Implementation of prescribed fires is now undertaken by relevant state and federal government departments.

The Appalachians offer spectacular scenery, recreation and connection with nature, including a 3500 km trail through 14 states and eight national parks. The view from the summit of Old Rag Mountain in Shenandoah National Park, also enjoyed by the majestic Bald Eagle, is magnificent in the breeze of a perfect sunny Fall afternoon.

Update on my research

I am investigating partner choice in mycorrhizal symbioses of the terrestrial orchid genus *Platanthera*. As in Australian terrestrial orchids, *Platanthera* has a perennial life cycle and undergoes a period of seasonal dormancy where above ground organs are senesced and the plant remains underground as a quiescent tuber. The majority of North American terrestrial orchids are dormant during the cold winter months rather than the summer as in Australian terrestrials. During autumn (September to November), I collected seed and root samples from 14 *Platanthera* species (including two natural hybrids) in 30 populations



View in Shenandoah National Park. Photos: Zoë Smith

across six US states. Mycorrhizal fungi were isolated from the root samples and cultured for identification and seed germination. Now that the growing season has ended, it's time to head back to the lab and see which *Platanthera* species will 'partner up' with which fungi.

Research highlights

An interdisciplinary team of scientists at the Smithsonian Environmental Research Center has been granted \$5 million from the National Oceanic and Atmospheric Administration (www.noaa.gov/stories/2009/20091030_chesapeake.html) to improve understanding of the factors behind the poor health of the bay and the impact on native plants and animals.

Researchers at the Smithsonian Tropical Research Institute in Panama have provided the first empirical evidence for

a mutually beneficial cleaning relationship between two different species (bees and mites) on land (www.stri.org).

Elevated atmospheric CO₂ has been shown to stimulate soil elevation in a brackish marsh, potentially counterbalancing sea-level rises (www.pnas.org/content/106/15/6182.abstract).

Researchers have found 17 types of actions that could significantly reduce annual household carbon emissions to generate short-term greenhouse gas reductions (www.pnas.org/content/early/2009/10/23/0908738106).

A review of 22 years of literature surrounding biodiversity management in the face of climate change provides a consensus of recommendations and outlines future directions (www.elsevier.com/wps/find/journaldescription.cws_home/405853/description#description).

Report from New Zealand Plant Conservation Network

Bec Stanley

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Council update

The next New Zealand Plant Conservation Network (NZPCN) Council was elected at our AGM in November 2009. Susan Wiser (Landcare Research) and Daniele Hancock (Waitakere City Council) have joined the Council (following Ian Spellerberg and Bec Stanley standing down). The Network's new President is Philippa Crisp (Wellington Regional Council). Outgoing President Professor Ian Spellerberg noted that as the largest NGO in NZ with a focus on native plants, the Network makes substantial contributions to plant conservation. However he also reminded us that although there was much to be positive about, the conservation status of the country's flora is worsening and there are continuing threats to native plants and native plant communities throughout it on both public and private land. Recent Government cuts to conservation do nothing to reverse these trends. Professor Spellerberg described conservation as a fundamental basis for sustainability and quality of life and that we have a moral obligation to conserve and restore native plant species and communities. He left us with a challenge that there is still much work to be done to educate, engage and inspire New Zealanders to restore, appreciate and protect our native plant species.

AGM & Ecosourcing debate

A fascinating trio of talks followed the AGM discussing the genetic reasoning and practicalities of ecosourcing, i.e. collecting native seeds close to the location of the restoration site (in amounts that reflect local patterns).

Speakers were Leon Perrie (Te Papa), Chris Ferkins (Waitakere City Council) and Wayne Bennett (Ecosourced Waikato). The conclusion was that it is commonsense to conserve local patterns of biodiversity as it is not in the interests of long-term conservation principles to knowingly disrupt this. 'Friendly audits' of nurseries have been successful at Waitakere with reliable supplies of ecosourced plants now available. Some challenges of these systems were mentioned, including planting plans from landscapers which require ecosourced plants but include plants not native to the area, indicating more education is needed. The talks will be available on our web site.

Awards

The AGM is the network's opportunity to celebrate individuals, schools, groups, nurseries and local governments excellent work in plant conservation. This year's individual award went to Graeme Atkins, a Department of Conservation ranger who works full time caring for plants including *Clianthus maximus* and *Dactylanthus taylorii* on the North Islands' East Coast. Graeme has developed innovative survey and management techniques, including analysing possum stomach contents for parts of a secretive parasitic plant (which possums can find faster than humans because of its scent), and using animal repellents developed for forestry to prevent browse on native plants. The Local Government award went to Waitakere City Council who developed a threatened species policy which is intended to protect threatened plants on private land.

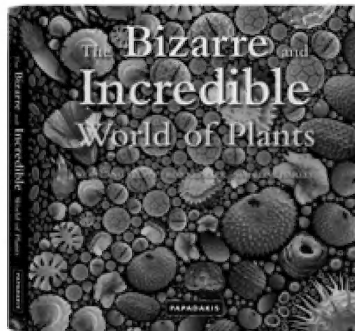
Book Review

The Bizarre and Incredible World of Plants

by Wolfgang Stuppy, Rob Kessler & Madeline Harley,
Papadakis Publisher, London, 2009, 144 pages.

ISBN 978-1906506-02-5 £20.00

Available from: www.papadakis.net



At a glance *The Bizarre and Incredible World of Plants* could be passed off as a children's book with its vivid, almost gaudy, exterior. On closer inspection the extravagant cover reveals an ornate arrangement of seeds, pollen and fruit and is the first introduction to an intriguing blend of science and art.

The Bizarre and Incredible World of Plants draws on the artistic skills of Rob Kessler and the scientific expertise of Madeline Harley and Wolfgang Stuppy (from the Millennium Seed Bank, Royal Botanic Gardens Kew, UK). The book could be seen as a compilation of the three previous coffee table masterpieces by the same authors: *Pollen – The Hidden Sexuality of Flowers*, *Seeds – Time Capsules of Life*, and *Fruit – Edible, Inedible, Incredible*. As such, the exquisite content provides an interesting read about the complex world of plants.

The superbly detailed images, captured using outstanding camera techniques and scanning electron microscopy, are balanced with informative and easy to understand text throughout the book. For those who need a greater level of detail, the list of illustrations at the end of the book will prove informative. A small disappointment is that a reader can't determine the species name or scale of the images without referring to the back of the book but doing so would detract from the sleek layout. Also, like its predecessors, the black glossy pages are a magnet for fingerprints but you will need to get past this quickly to enjoy the book.

Many passers-by to my desk have asked 'Is that seed really that colour?'. Rob Kessler has used artistic licence to colour many microscopic images contained throughout.

Whilst the colouring may be unnecessary it heightens the complex architectural detail that nature displays at a level beyond the view of the naked eye.

While you could easily just gaze at the pictures, the storyline presents a compelling narrative about the life of plants and, in the process, reveals their ornate and, in some cases, sadistic nature. The book

details the microscopic world of pollen, the dust-like seed of orchids through to the world's largest seed, the giant Coco de Mer. Seed dispersal is well covered including the couriers, the hitchhikers and the ballistic seed dispersal mechanisms (like that of the Sandbox tree which can hurl seeds up to 14 m, or the cruel nature of the Devil's Claws that penetrate the skin of passing animals).

A personal favourite are the sea beans that have historic uses including snuff boxes, teething rings, jewellery and talismans to ward off evil spirits. In particular the sea bean that looks like a cheeseburger is a standout.

If you haven't purchased 'Pollen', 'Seeds' or 'Fruit' previously, this is one book you should definitely add to the collection. There are many Australian examples throughout the book providing relevance to a local audience.

The Bizarre and Incredible World of Plants presents a spectacular close-up view of a world we think we already know. This should be compulsory viewing for school students to inspire a new generation of children to take an interest in the amazing world of plants and is a wonderful resource for educators. The images are worthy of an exhibition in a national gallery and would be equally at home on your coffee table or office bookshelf.

John Siemon, Science Facilities Coordinator, Mount Annan Botanic Garden, NSW.

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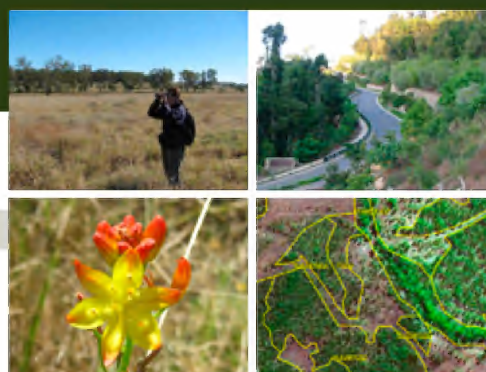
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Planning conservation to achieving restoration:

*A conference for everyone involved in conserving
Australia's unique flora and native vegetation*

28 September to 1 October 2010, Perth WA

This conference is for practitioners, researchers, governments, community groups, non-government organisations and anyone else interested in plant conservation.

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Banksia brownii. Photo: David Coates



Calytrix brevipes. Photo: Andrew Crawford



Photo: Melany Smith



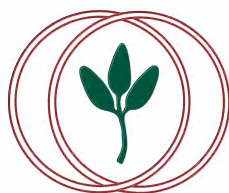
Verticordia albida. Photo: Andrew Crawford



Banksia myrsina. Photo: Greg Le Goff



Jacksonia rugosa. Photo: Andrew Crawford



Australasian Plant Conservation

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